U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB80-103963

Recent Developments in Urban Transportation

NATO Committee on the Challenges of Modern Society Brussels (Belgium)

Jun 78

P880-103963

Committee on the Challenges of Modern Society

Recent Developments in Urban Transportation

Followup Report of The NATO/CCMS Urban Transportation Pilot Study

CCMS REPORT NO. 82

Urban Travel Forecasting
(CCMS REPORT NO. 87)

Demand Systems (Dial-A-Bus) Evaluation
(CCMS REPORT NO. 53)

Bus Priority Systems
(CCMS REPORT NO. 45)

Urban Goods Movement
(CCMS REPORT NO. 86)

Evaluation of Short Distance Transport Techniques
(CCMS REPORT NO. 57)

June 1978

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

U.S. Department of Transportation

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
CCMS Report No. 82		PB80-103963

4. TITLE AND SUBTITLE	5. REPORT DATE
Recent Developments in Urban Transportation	June 1978
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS A followup report of the NATO/CCMS Urban Transportation Pilot Study	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS North Atlantic Treaty Organization Committee on the Challenges of Modern Society	13. TYPE OF REPORT AND PERIOD COVERED
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This is a followup report that incorporates a summary of developments in American cities during 1975-1977 and developments in the participating countries since the initial reports were issued. The following topics are discussed: go to p.ia

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
		79
	20. SECURITY CLASS *(This page)*	22. PRICE
		PCA05 MFA01

EPA Form 2220-1 (9-73)

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FOLLOWUP REPORT OF THE

NATO/CCMS URBAN TRANSPORTATION PILOT STUDY

EXECUTIVE SUMMARY

Overview

In recognition of the increasing dependence of cities on efficient transportation which preserves urban amenities, the Urban Transportation Pilot Study was proposed by the United States at the 1972 Spring CCMS Plenary Meeting. The Study was approved in February 1973. Projects included in the Pilot Study were:

1. Urban Travel Forecasting
2. Demand Systems (Dial-A-Bus) Evaluation
3. Bus Priority Systems
4. Urban Goods Movement
5. Evaluation of Short Distance Transport Techniques

Reports on the five projects were published and distributed in 1975-76. Developments in U.S. cities during the period 1975-77 were summarized in a report prepared by the U.S. Department of Transportation in October 1977. The followup report incorporates that material and also describes developments in the other countries participating in the Pilot Study since the initial reports were issued.

Urban Travel Forecasting

The objective of this project was to provide guides for a simpler, less costly, generalized urban travel forecasting procedure to provide quick information on the future growth patterns of urban travel. The study tested the ability to estimate trip generation by a procedure which would be applicable in different national settings as well as different urban settings. The report concludes that the cross-classification technique may have validity, and that its use should be considered by local officials looking for a simple, inexpensive method to estimate tripmaking. Applications of the technique have increased steadily, though slowly. The principal reason for this slow rate of growth is reluctance to abandon familiar approaches, such as zonal analysis and regression techniques for new, uncertain methods.

Demand Systems (Dial-A-Bus) Evaluation

The purpose of this project was to estimate the demand for dial-a-bus service in Waterloo, Belgium. Waterloo is typical of numerous communities in Europe as well as the U.S. in that local trips are not well served by conventional bus service because origins and destinations are widely dispersed. Because taxicab fares were considered out of reach of many tripmakers, the government decided to examine the feasibility of an innovative paratransit service.

The Belgian government recently decided, however, to provide mini-bus services to the elderly and handicapped in the Brussels area rather than initiate a Waterloo dial-a-ride service.

Bus Priority Systems

The purpose of this study was to examine priority schemes for buses and carpools in downtown areas, and on freeways which are major commuting corridors, to determine the feasibility of priority measures to reduce the travel times of high-occupancy vehicles, and to ascertain the extent of potential detrimental effects on other traffic. The report concluded that schemes giving priority to high-occupancy vehicles are a viable means of improving transit service and ridership in cities with dispersed populations, particularly for the journey to work.

There has been little innovation in bus priority systems since the 1975 report. However, there has been considerable work in refining and summarizing the state-of-the-art and preparation of guidelines for implementation. In Europe as in the U.S., an increasing number of cities are implementing schemes to give priority to high-occupancy vehicles. Several projects are planned for the new town of Saint Quentin in Yvelines, France, and a comprehensive bus priority system has been prepared for Besançon. In England, additional lanes have been extended. In Canada, new exclusive bus lane systems have opened in Halifax, Montreal, Quebec City and Edmonton.

Urban Goods Movement

The purpose of this study was to examine problems created by the movement of freight in urban areas, with the emphasis on "LTL" (less than truck load) shipments. The report reviewed the characteristics of freight activities which are essential to understanding UGM and to developing strategies to improve the efficiency of freight movements, and reviewed a number of alternatives which have been proposed to improve physical distribution in cities and better integrate freight movements with other transportation and economic activities.

The following topics were examined: traffic problems; technical problems; freight terminals; planning, regulation and commercial use; and demonstration of new projects.

Recommendations were made for dealing with each of the five major problem areas, and specific proposals were made for additional research.

Since the report was completed, England has completed studies of goods movement flows and related problems in Hull, Swindon, and London. This work has advanced the state-of-the-art of modeling urban freight movements. A number of European cities have taken steps to reduce freight-passenger conflicts in conjunction with their traffic restraint schemes, particularly where auto-restricted zones are employed. Freight consolidation schemes are being considered or implemented, particularly in Holland.

Intermodal Considerations and Evaluation of Short Distance Transport Techniques

The purpose of this report was to examine a spectrum of urban transportation systems and vehicles operating in 1975, or expected to be operating by 1980. A number of alternatives under consideration by individual CCMS countries, particularly those involving fixed guideways, were described. It concluded that if public transportation is to be a serious alternative to the private automobile, it must meet rather high standards with respect to traveltime, comfort and frequency. Only a relatively few public systems offer such standards at this time.

Some recent paratransit developments (dial-a-ride and priority treatment of buses) are described in other parts of this report. Vanpools and commuter bus clubs have been organized in England in collaboration with U.S. On the hardware side, Volvo and Saab have developed prototype taxicabs which offer full accessibility to the handicapped. Lille, France, has constructed a personal rapid transit (PRT) line to a satellite near town. Germany has a PRT prototype "Cabintaxi" system operating at a test site in Bremen, and a "Cabinlift" system transporting passengers buildings at a hospital in Ziegenhain.

INTRODUCTION

Overview

In recognition of the central importance of urban transportation to the problems of modern society, the Urban Transportation Pilot Study was proposed by the U.S. at the 1972 Spring CCMS Plenary Meeting. Based on the results of a Committee of Experts meeting convened at The Hague in September 1972, the Committee on the Challenges of Modern Society at the 1972 Fall Plenary recommended to the North Atlantic Council that such a study be undertaken. The Study was approved in February 1973. Projects included in the Pilot Study were:

1. Urban Travel Forecasting
2. Demand Systems (Dial-A-Bus) Evaluation
3. Bus Priority Systems
4. Urban Goods Movement
5. Evaluation of Short Distance Transport Techniques

The projects were completed in 1975-76 and distributed among CCMS members and other countries which expressed interest.

Unlike many other CCMS projects, this Pilot Study was not predominantly technological or scientific in nature. The work of this Pilot Study reflects the growing realization that massive investments in more transportation capacity will not alone resolve the many complex and taxing problems that characterize urban transportation in today's large cities. The criteria for selecting the projects were:

- the project must be well-defined;
- the project must be action-oriented;
- the project must have a finite lifetime;
- the project must translate existing knowledge into practical application; and
- the project must reflect some commonality of programs among CCMS members.

It is important to bear in mind that, while these projects share the common ground of urban transportation, each project is an essentially self-contained effort, relatively independent of the others both in terms of the work done and the conclusions reached.

It is useful here to give some attention to the general nature of the outputs that we are getting from the projects. There is nothing revolutionary in these reports for they cover areas familiar to experts in the field. What the reports do embody are some marked advances from the current conventional wisdom in areas of considerable interest to urban transportation experts in all modern countries. Further, the studies deal with areas in which it is difficult to make sweeping general recommendations which can be readily adopted by NATO governments as "policy." Indeed, much of the work deals in areas where many of the principal decision prerogatives lie in the hands of local, not central governments.

The Present Situation

The five pilot studies and developments which have occurred in the subject areas since the reports were completed portray a discernible shift in public policy toward urban transportation. Increasingly, management and operations-oriented strategies which emphasize non- and low-capital intensive measures to improve urban transportation services, to reduce environmental impacts and conserve energy are given higher priority than long-term, capital intensive programs. While management strategies have not replaced capital programs (and indeed probably never will), the change in policy is now taken for granted.

If during the 1980s and 1990s, the decade of the 1970s stands out as the period when the change in emphasis occurred, 1975 may well prove to be the benchmark. During that year, the OECD Conference "Better Towns with Less Traffic" was a catalyst which challenged the conventional approaches to urban transportation planning and proposed a new philosophy and alternative means of improving transportation services in cities. The five NATO/CCMS urban transportation reports were also completed in that year and reflected the same shift in emphasis.

In the U.S., the Department of Transportation issued a regulation requiring that in order to be eligible for Federal assistance for mass transit, cities would be required to make better use of existing transportation resources by implementing Transportation System Management (TSM) strategies (see Appendix B). The regulation also required that applications for assistance for major capital (i.e., rail transit) projects include an analysis of the potential of less costly alternatives for achieving the same levels of service. Rapidly rising costs of constructing and operating rail systems, plus mechanical problems and ridership levels below those anticipated, also contributed to a change in emphasis from costly, capacity-oriented improvements, to less expensive, management-oriented solutions. Growing operating deficits in bus as well as rail operations convinced still more people of the necessity to pursue transportation system management policies. The TSM philosophy is gaining acceptance by transportation professionals and elected officials at all levels of government.

It is hoped that the five Urban Transportation Pilot Study reports and recent developments in the subject areas described in this report will stimulate the exchange of information and cooperation among CCMS members.

URBAN TRAVEL FORECASTING

Lead Country: United States

Participating Countries: Federal Republic of Germany, Netherlands, United Kingdom

1976 Report

The Urban Travel Forecasting project was undertaken in response to the increasingly frequent requirements for public officials and decisionmakers to evaluate alternative courses of action and investment dealing with transportation services. The economic and social implications of such actions demand that the decision-maker have at hand the best and most efficient tools to aid in making those decisions. Moreover, recent attitudes toward growth and uncontrolled urban expansion have drastically changed, becoming more concerned with the consequences of not making a certain transportation investment rather than determining what investments need to be made to meet the otherwise unconstrained demand for transport services. In addition, it was felt that by simplifying and achieving a degree of standardization in travel estimation procedures, benefits could accrue to the user nations in the form of time and cost savings as well as broadening the spectrum of conditions under which the forecasting procedure can be expected to operate.

The objective of this project was to provide guides for public officials in developing estimates of future travel likely to materialize if existing trends were allowed to continue. Because of the differing views taken toward the automobile and its relationship to urban development by Europe and the U.S., it is advantageous to draw on the experiences of each as analogues of what might happen under existing trends. Specifically, the goal was to provide a simpler, less costly, generalized urban travel forecasting procedure to provide quick information on the future growth patterns of urban travel.

The project also explored the generality of travel demand characteristics as viewed from an international perspective. More specifically it tested the ability to develop a generalized trip generation procedure that could be utilized quickly and easily on a multicountry basis to provide information on tripmaking that would likely occur under varying assumptions of socioeconomic activity. The project results demonstrate a usefulness to decision-makers, by providing information on potential trip generation activity likely if trends in motorization continue. Experience in European urban areas were contrasted with U.S. conditions both from a national perspective and specifically for the cities analyzed in Phase II. The report concludes there is evidence that

the cross-classification technique may have validity and that its use should be considered by local officials who find it convenient to use an inexpensive method for trip estimation. The report recommends that additional analysis be undertaken utilizing data from a number of countries in order to carry further the validation of this technique and to further refine it.

Present Status and Recent Development

Although the general area of disaggregate travel demand forecasting techniques is receiving substantial attention, cross-classification -- the specific approach treated in this report -- has not been a particular focus of this attention. Applications of the technique have increased steadily, though slowly, on the part of local planners. The principal reason for this slow rate of growth is seen as the usual reluctance to abandon familiar approaches, such as zonal analysis and regression techniques for new, uncertain methods.

In order to deal with this user reluctance, the planning assistance programs under the direction of the Federal Highway Administration (FHWA) and Urban Mass Transportation Administration (UMTA) of the United States Department of Transportation have disseminated material describing and advancing cross-classification technique applications. The Federal Highway Administration has published a report entitled Trip Generation Analysis which describes the approach and recommends appropriate applications. The Urban Mass Transportation Administration has under development a computer program to provide a generalized summarization, cross tabulation and statistical capability for the Urban Transportation Planning System, which UMTA and FHWA distributed as a basic planning support system. This program will facilitate trip generation analysis by the cross-classification method by allowing computer access to secondary data sources and by incorporating screening and editing procedures to assist in the detection of erroneous or illogical values. These activities are a direct outgrowth of the methods documented in this project report.

The European Conference of Ministers of Transport in Passenger Transport Demand in Urban Areas, Methodology for Analyzing and Forecasting (Roundtable 32, 1976) identified the follwing shortcomings of current travel forecasting techniques:

> "-- the need to draw upon a variety of techniques in demand models and research including those of disciplines outside economics and in particular, to combine the approaches of economics and social psychology;
>
> "-- the need at assessment level to abandon attempts to express findings as a single future, to think instead in terms of multicriterion analysis; the

main object being to identify the tradeoffs and to clarify the options confronting the decisionmakers;

-- most important of all, the need for findings to be presented intelligibly, and in such a way that everyone can understand them...

If transport analysts concerned themselves more with social psychology and less with quantification -- as in the interests of greater relevance they ought -- they could do much to make demand studies more comprehensible to decisionmakers."

DEMAND SYSTEMS (DIAL-A-BUS) EVALUATION

Lead Country: Belgium

Participating Countries: Canada, France, United Kingdom, United States

1975 Report

CCMS Report 53 was completed in 1975. The purpose of the project was to estimate the demand for dial-a-bus (DAB) service in Waterloo, Belgium (see Appendix A-2). Waterloo is a suburban satellite with a population of 20,000 and is about 18-28 minutes from Brussels, the chief source of employment. It is similar to many European and U. S. communities in that although income and auto ownership are comparatively high, many households do not own cars. Because the density is low and the major trip operations (schools, medical centers, retail stores, and places of employment) are dispersed, some form of master vehicle transport is deemed essential (see Table 1). The high cost of taxi service but inadequate demand for conventional bus transit creates a situation where the community faces a choice between no public transportation, aside from the taxicab, and some form of paratransit. The municipal government opted for the paratransit alternative, specifically some form of "pick-up-on-demand" service.

The project was organized into three major tasks:

(1) Obtain basic information about travel patterns and preference functions by means of household interviews;

(2) Process the information to put it into a usable form; and

(3) Analyze the information to determine the demand for dial-a-ride services.

Step (1) was accomplished by employing professional canvassers to interview 20 percent of the population. This information was key-punched in Step (2) and checked for validity. In Step (3) the information was stratified according to the different market segments, and regression techniques were employed to estimate probable ridership (Table 2).

The analysis concluded that there are two probable groups of riders:

- those who reacted favorably to the prospect of using DAB regularly and frequently for school and work-related travel; and

- those with a wait-and-see attitude, but who would at least use it occasionally.

TABLE 1

DISTRIBUTION OF TRIPS ACCORDING TO PURPOSE AND MODE

	Work	School	Shopping	Side Activity	Medical centre
Car	67.7	20.3	71.7	48.5	67.3
Urban transport	5.8	8.0	11.5	20.5	7.8
On foot, bicycle, motorcycle	26.5	71.7	16.8	31.0	24.9

TABLE 2

WATERLOO DEMAND FOR DIAL-A-BUS (CONSERVATIVE ESTIMATE)

Journey motive	Number a day	Relative importance
Work	176	14.5
School	451	37.1
Shopping	438	36.0
Side activity	40	3.3
Medical centres	111	9.1
Total	1,216	100.0

It was also predicted that the demand for other trip purposes, particularly shopping and health-related, would be at least as large as the work and school trips.

Present Status and Recent Developments

Dial-a-Bus as a Form of Paratransit

The most highly organized paratransit service is known as demand activated transportation, in which persons desiring transportation call a central office indicating their place of origin and their destination. A bus is dispatched to pick up the caller at his or her doorstep and then transports the rider to the doorstep at the ultimate destination. During the trip, the bus may pickup and discharge other people who have also called for transportation service. This scheme has been given a variety of names: dial-a-bus, dial-a-ride, genie (rub a telephone and a genie will appear), demand activated rapid transit (DART), to name a few.

In cities of the United States and Europe, dial-a-bus programs have been implemented and there are data available about its operations. Dial-a-bus service can be provided in three ways, many-to-one, many-to-few, and many-to-many. Many-to-one is service provided to a single destination from many origins within the community. An example of this would be dial-a-bus service to a transit station or to an airport. Many-to-few service provides transportation to more than one activity center such as shopping centers, downtown, transit terminals, etc. Many-to-many is service for all types of trips to all destinations within a prescribed area (the type of service intended for Waterloo).

Variations in dial-a-bus systems include buses operating on fixed routes but which deviate in response to requests for door-to-door service. The second is a fixed schedule bus service within a prescribed area and over a known time period but with randomly selected routes determined by passenger demand. A third type is a completely dynamic system in which both routes and schedules are determined by demand as a function of both space and time.

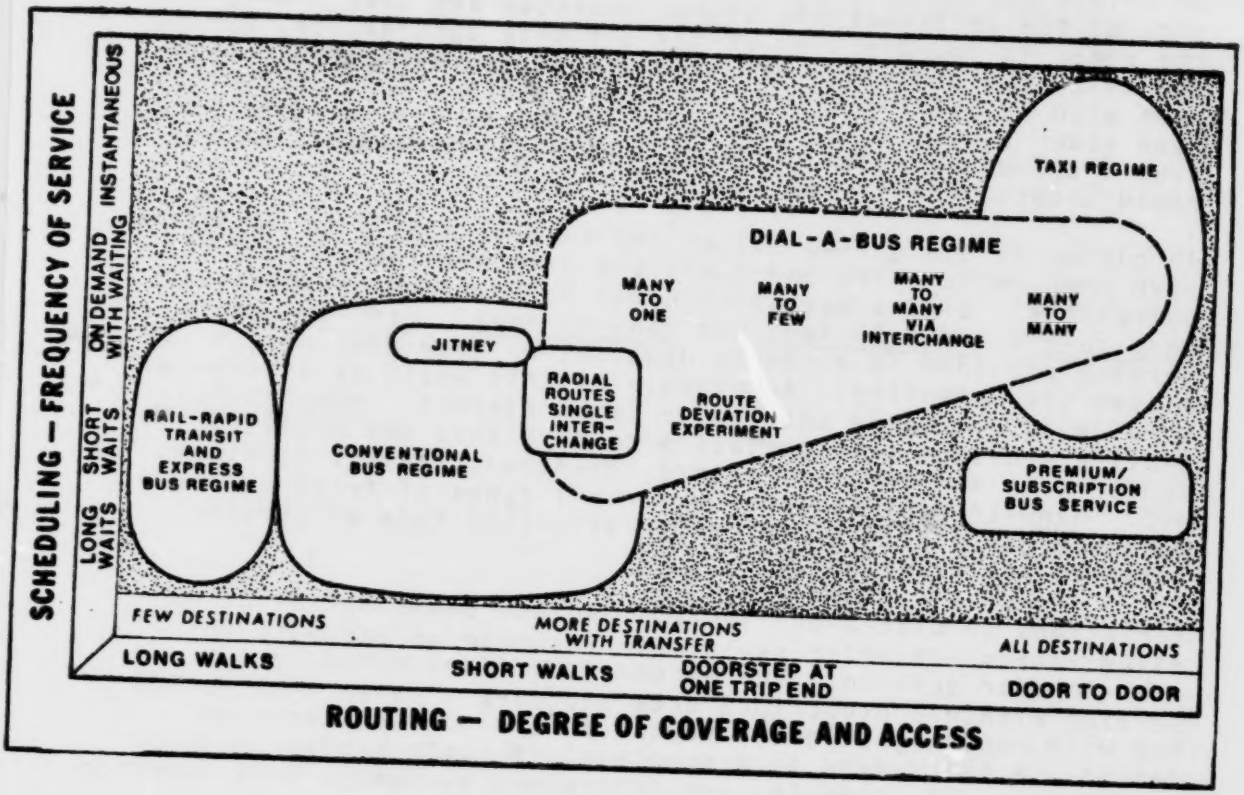
A conceptual framework relating the different types of DAB services to each other and to other forms of public transportation is shown in Figure 1.

North American Experience

Results of operations of dial-a-bus systems in twelve U.S. and Canadian cities give some insight into the probable

FIGURE 1

Conceptual Framework for
Dial-A-Bus Services



effectiveness of this type of transit service. Studies have indicated that where fares range from zero to sixty cents, daily ridership on manually-dispatched dial-a-bus systems ranges between 100 to 400 persons per day in cities of 10,000 population and 1,000 to 1,400 persons per day in cities of 100,000 population. A linear relationship appears to exist between these two extreme points. Furthermore, peak-hour ridership appears to be about 10 percent of daily ridership. Obviously, factors other than population are relevant and this range has been exceeded in some cases, especially where captive riders are a high proportion of the population, or where large trip generators exist such as shopping centers, hospitals and rail-line terminals or where special services may be provided, for example, to senior citizen homes, for shopper specials, etc. But as a rough measure of potential, it would appear that daily ridership is about 1 percent of total population for city sizes between 1,000 and 10,000.

Experience throughout the United States indicates that revenue for dial-a-bus systems does not meet operating expenses. The subsidy required per trip could involve up to $5 a person, and in some demonstration programs, the cost per trip exceeds $2.50. Experience with dial-a-bus systems indicates that generally they are well received because they give increased mobility for many citizens. Dial-a-bus systems have been in operation in recent years, all manually controlled and dispatched. The waiting time between placing a telephone call and the arrival of a vehicle is about 15 minutes and the average trip is about 20 minutes. Thus, despite their billing as instant door-to-door transportation, dial-a-bus systems do not compete directly with service provided by the automobile. Waiting times are longer and traveltimes are longer. In fact, the ratio of the trip time by dial-a-bus to the time by auto may be as great as 2 or 3 to 1. However, for many citizens who must depend on public transportation and have none available because the community cannot support a fixed bus or rapid transit system, dial-a-bus represents an efficient and sensible solution.

Dial-a-bus systems represent a quite modest attempt to improve transit service in smaller cities. Most communities served have populations of fifteen to twenty thousand persons, serving areas of between two and six square miles (i.e., similar to Waterloo). In general, small vehicles have been used, ranging in size from ten to twenty-five seated passenger capacity. Experience indicates that bus capacities of about fifteen seats are adequate. Services that have been implemented vary quite widely, ranging from simple deviations from a fixed route to a many-to-many service covering an entire urban area. These results illustrate one of the principal attributes of demand responsive systems. They can be used in ways that fit community needs, and modifications in the service can be made on demand. All of the systems have used manually operated dispatching techniques, an approach that works well for systems of ten or fewer buses.

After nearly a decade of experimentation in Canada, door-to-door service appears technically achievable, but it implies a cost penalty which can be justified only in exceptional situations. As a result of this finding, new development work in Canada is being directed along two major axes:

(a) "Grouping," "simplifying" or "degrading" service so that clusters of dwellings are served rather than offering individual doorstep service. Some of the names for these reduced services include "Stop to Stop Dial-a-bus" and "Divert-a-bus."

(b) "Information transfer" to ensure that the passenger gets to the bus stop at the exact time the bus arrives. The objective under this second axis is to find ways to reduce the wait of the passenger to some sort of minimum.

In response to this last, the Transport Development Agency (TDA) has developed a system called ABPI -- the Automated Bus Passenger Information System which it is currently demonstrating and perfecting in Mississaugi, Ontario. The outline of the system workings is as follows: Passengers living on an ABPI route call an information number (on a digit dial phone) to determine the estimated time of arrival (ETA) and estimated loading status (ETS -- e.g., standing room only, nearly full, half full, etc.) of the next bus. If they wait, they will be given information about the following bus as well. This allows the passenger to time his departure in order to reduce waiting time to a minimum. The pilot project was initiated in December 1975 and achieved the following results. Overall traveltime on the route (round trip) was reduced from 120 to 90 minutes. Average waiting time for users was reduced from more than ten to about three minutes. Bus occupancy rates have improved substantially and bus patronage along the route seemed increased by nearly fifty percent in the first six months of the project. The ABPI system is gradually being refined, upgraded and automated, and it is the intention of the TDA to develop further service in the immediate future.

European Experience

There are several dial-a-ride operations in Europe, including those in some rural areas of Sweden, and in St. Cloud, Angers and Conflans-Ste. Honorine, France. After evaluating the projected deficits of the proposed Waterloo dial-a-ride service, the Belgian government elected to provide services to the elderly and handicapped in the Brussels area rather than implement the DAB service at this time. Tradeoffs between the two types of services are being evaluated in other cities in Europe and North America.

In Germany, a consortium of firms led by Messerschmidt is marketing a "many-to-many" demand responsive DAB system which picks up and discharges passengers only at predetermined DAB stops. The heart of the system, called "RETAX," is a bus stop with an automatic destination selector. The passenger makes a request for service by using the selector, which transmits the information to a control center. The control center selects the vehicle which can best comply with the request, and informs the passenger of the number of the vehicle and the probable time of departure. When the passenger purchases his ticket by inserting money into the destination selector, booking is also accomplished. The ticket shows the bus number and the time of departure. On the basis of a feasibility study based on the socioeconomic characteristics and travel data of Ahrensburg, a community of 25,000 population approximately 25 km north of Hamburg, the German Ministry of Research and Technology are looking for a test site, and RETAX has applied for patents in North America.

Demand-responsive transportation services is one of the topics being reviewed by the OECD Research Group UT2 Project, "Transport Service in Low Density Areas." This international survey of the state-of-the-art will be completed and distributed in 1978.

Observations

In the last several years, dial-a-ride has progressed from the research to the operational stage. It was conceived as a hybrid to provide transportation services which approach the flexibility and service characteristics of the taxicab, but for fares which approximate those of conventional bus transit. While important transportation services are being provided by this type of paratransit, virtually all dial-a-ride services operate at a loss, and frequently require substantial subsidies.

The slow pace of dial-a-ride implementation in spite of the recent recent advances in demand-responsive technology indicates that the greatest deficiencies at present are institutional, not technological. While CCMS members undoubtedly will benefit from

technological sharing, they might help each other more by attempting to improve the institutional environment for dial-a-ride, and sharing the results. Candidate topics for useful collaboration among CCMS members include the following:

1. ways of easing economic regulations to permit demand-responsive services by private operators, for example, the shared-ride taxi;

2. innovative labor arrangements, for example, use of part-time drivers; and

3. integration of dial-a-ride services with conventional transit.

BUS PRIORITY SYSTEMS

Lead Country: United Kingdom

Participating Countries: Canada, France, United States

1976 Report

Bus Priority Systems, CCMS Report No. 45, examined priority schemes for buses and carpools in downtown areas and on freeways which are major commuting corridors (see the Conclusions and Recommendations in Appendix A-3 of this report). While all of the participating countries had implemented with-flow and contra-flow schemes in downtown areas, the U.S. and Canada were the only countries which had implemented schemes which gave buses priority-on-freeways. The report noted that with the increase in the number of freeways approaching large European cities, freeway bus priority schemes will probably become an increasingly viable option there too. However, bus-only streets and busways have gained much greater acceptance in European cities, particularly in Germany and England. Similarly, there were no North American cases which gave buses priority at traffic signals, (as in Glasgow and Derby, U.K.), or where a comprehensive bus-priority scheme had been adopted for an entire city (as in Reading, U.K., Bremen, Germany, and Göteborg, Sweden). Experiments with bus priority at traffic signals have since been conducted in two U.S. cities: Miami, Florida and Washington, D.C.

The report concluded that schemes giving priority to high-occupancy vehicles are a viable means of improving transit service and ridership in cities with dispersed populations, particularly for the journey-to-work. The project found that although there are implementation problems, noticeable disbenefits to auto users are minimal, and that frequently both auto and transit riders enjoy faster traveltimes as a result of well-conceived bus-priority schemes.

Present Status and Recent Developments

The main conclusions of the report are still valid and the recommendations made are still pertinent. It is true that there have been some changes in emphasis in the implementation of bus priority schemes since the report was published, and some results of individual schemes are different in degree from the provisional ones reported in CCMS Report No. 45. However, the main impact of the report remains unchanged. Some new schemes have been implemented (and some taken out) and these further developments are reported in more detail in the next section.

United Kingdom

There have been no major changes in developments in bus priority over the last two years in the UK, though there have been some changes in emphasis; some major schemes have come to fruition and in one case a major scheme has been abandoned. The publication of a Government White Paper on Transport Policy has stressed the need to help buses, and there has been an increasing tendency to adopt low-cost solutions to transport problems in contrast to the high-cost solutions which were favored a few years ago.

Bus lanes, both with-flow and contra-flow, have continued to increase in number throughout the country though in certain areas, and particularly in London, there has been some pressure very recently to reduce the number of such schemes. The use of a setback space, as recommended in chapter 3 of the report, was fairly common practice at the time of writing the report, and is now almost universal, with encouraging results. The latest growth area in priority measures is selective vehicle detection (SVD) at traffic signals, but the benefits to buses from such schemes are generally very modest. Equipment for SVD had to be specially made for the earlier installations but now it is available "off the shelf". Area traffic light control systems are installed in only a small number of cities in the UK and as yet those incorporating bus priority facilities are few. There has been a tendency recently to use traffic control systems in towns much smaller than the main conurbations in which the original experiments were carried out.

The use of bus-only streets has continued to grow. In Leeds, for example, a major 4-lane thoroughfare in the main shopping area has been converted to a 2-lane bus-only road with pleasing results from the shoppers' point of view (though not necessarily from the car users' viewpoint). One of the more famous schemes, Oxford Street in London (described in chapter 7 and appendix 1 of the report) continues to perform satisfactorily as a bus and taxi road. The busway scheme in Redditch (chapter 8 of the report) has progressed further and is now about two-thirds complete: it is already proving its worth and Redditch is one of the few places in the UK where bus travel per head of population is actually increasing. The Runcorn Busway has also been extended but is still not complete. However, the preliminary economic assessment given in the report remains valid.

One priority experiment which has not proved successful is the "zones and collars" experiment in Nottingham (described in chapter 11 of the report), in which a policy of traffic restraint,

using traffic signals to prevent too many vehicles entering the town center in the morning peak period, was combined with bus priority (special bypass lanes for buses to avoid the queues at the traffic signal "gates"). The assessment showed that buses saved less than one minute between the residential area and the town center, while non-bus traffic was delayed, on a average, by up to 1 ½ minutes, depending on the route chosen. The costs of the scheme for one year of operation are estimated at £280,000 and the net disbenefits to all traffic amounted to about £5,000 per annum mainly in time and operating costs of private cars and commercial vehicles. The scheme has now been abandoned, but the knowledge gained from the assessment study is of very real value.

France

Concern for improving the operational efficiency of buses, which began several years ago, has continued unabated, and measures to assist buses are now an accepted feature of any traffic or transport plan. In many town centers, as well as on some of the main radial corridors, there has been a tendency to select certain streets for upgrading and installation of appropriate bus priority measures, such as bus lanes in both directions and priority at traffic signals. Bus routes are then regrouped in order to exploit these priority facilities. One such system is being studied in Marseilles and another in Le Mans. Pedestrianizing streets and allowing access to buses either along or across them has been gaining popularity recently and such treatment is envisaged in several towns, e.g., Chartres, Metz and Lyon, where in the latter case a newly-pedestrianized street allows access to trolley buses.

Several projects involving the construction of busways, or sections of segregated tracks, are planned for the future and a start has been made on the construction of an 18km segregated busway, at an estimated cost of 179MF (at 1975 prices), in the new town of Saint Quentin in Yvelines. Stage 1, the construction of a 1km tunnel under the railway station, has been completed and the whole project should be completed by 1985. In the Paris region, it is planned to incorporate a 4½km segregated bus lane in a traditional urban arterial road (National Route 305), one of the main Paris radials. The segregated lane will occupy the middle section of the road and all the junctions will be at grade; it will have one or two lanes, as appropriate, and will designed for a cruising speed of 40-65km/h, allowing a timetable speed of 20km/h for ordinary bus services and 24km/h for limited stop services. It is intended that the lane will be in use by 1980.

The comprehensive scheme for Besançon was reported in detail in Chapter 11 of the report. Few modifications have taken place

since that account. However, in one city, a shared-ride taxi system was replaced by a minibus system, because of organizational problems and higher patronage levels than anticipated. A centralized control system for buses has also been set up in the town.

Canada

Since the time the final report was prepared, new exclusive bus lane systems have opened in Halifax, Montreal, Quebec City and Edmonton. The most popular and effective bus priority measures continue to be exclusive bus lanes, but interest appears to be leveling off, perhaps because the most promising opportunities have been exploited. The use of exclusive rights-of-way for light,rail vehicles or buses is likely to be the most popular technique in the future, with systems currently being contemplated, or in some cases actually being built, in Vancouver, Edmonton, Calgary, Winnipeg and Ottawa.

Some interesting technical work, including a simulation study of exclusive bus lane capacity in Ottawa, has been undertaken. The study concluded that, for the situation studied, bus flow rates of 150-170 vehicles per hour per lane could be achieved without resorting to extraordinary or unconventional operating strategies.

United States

Virtually all of the U.S. bus and carpool projects described in the 1975 CCMS report are presently operating, and at increased levels of ridership. Several cities have implemented "high-occupancy vehicle" (HOV) projects in the past two years, and many more are in the planning stage. These include freeway projects and several projects in the areas of bus-only streets, busways, and priority at traffic signals.

Probably the most significant development was the failure of the Santa Monica Freeway Diamond Lanes project, the first U.S. bus priority scheme to meet overwhelming public resistance. While it included priority access ramps, express bus service, park-and-ride lots, and a carpool matching service, the principal feature was a reserved median lane in both directions of a 10-lane divided freeway. The lanes were designated by signs and pavement markings and were reserved for buses and 3-person carpools between the hours of 6:30 to 9:30 a.m., and 3:00 to 7:00 p.m., Monday through Friday on a 12.6 mile section of the Santa Monica Freeway between Santa Monica and Los Angeles. The freeway operates at capacity levels during peak hours, and removal of one lane -- one fifth of the capacity -- from general

use created considerable resentment. The corridor receives heavy use by high-income commuters who habitually drive alone (the average auto occupancy is slightly over one person per vehicle) in a region generally recognized as "auto dominated." Insufficient advance publicity and guidance to users of the facility prior to implementation of this high-occupancy vehicle priority scheme exacerbated the situation, and there were numerous traffic delays and collisions during the first week of the project. The project was terminated in its 21st week by court order on the grounds that there had been no assessment of environmental impacts before it was implemented. Although the project was never judged a success by the majority of the users of the freeway it did perform well by objective standards:

- total traveltime savings for priority vehicles of up to 15 minutes;
- no increase in traveltime (as compared to preproject conditions) for nonpriority vehicles after the project had been operating several months;
- by the 21st week the number of carpool and bus riders had nearly tripled to about 21,000 weekly, nearly 17 percent of all freeway users compared to about 16 percent before;
- average vehicle occupancy rose from 1.23 to 1.36;
- the freeway carried 3 percent more people in 7 percent fewer vehicles;
- by the 18th week fuel consumption along the freeway and parallel surface streets had been reduced by 11,000 gallons a day, a savings of 7.6 percent.

In addition to the higher number of accidents during the peak periods (a doubling, mostly of the rear-end variety), enforcement was a problem, with 10-20 percent of the vehicles in the lanes authorized during the beginning and the end of the peak periods.

Thus, from a traffic management viewpoint the project cannot be judged a failure. The other changes related to the project have been continued. Moreover, similar projects are being planned for other routes in the Los Angeles area, and much has been learned about the prerequisites for a successful implementation of projects of this type, particularly in the aspects of public information and public participation in the planning and decisionmaking process.

The U.S. bus priority schemes described in CCMS Report 45 are all still in operation and performing at levels which are comparable or higher than described in 1975. For example:

- The number of bypass lanes on the metered ramps in Los Angeles has increased from one to 25. Twenty of the ramps accommodate carpools of two or more as well as buses, and five are bus only. More than 30,000 people per day in 10,000 carpools and 280 buses use the bypass lanes for time savings of 3 to 6 minutes. Fifty percent of the carpools were formed since the bypass lanes became available. In October 1975, no accidents had been attributed to the 13 bypass lanes then in operation, but enforcement has become more difficult as the number of ramps increased.

- In 1974, the two Shirley Highway reversible lanes accommodated 300 buses and 1,050 carpools of four or more during the morning and evening peaks. Currently they serve approximately 450 buses and 2,700 carpools. The two express lanes carry about 18,000 persons per hour, while the three regular lanes carry about 8,000 people -- but at lower speeds.

Successful priority or reserved lane schemes have been implemented during the past 2-3 years in a number of other U.S. cities. Evaluations have been made of projects in Honolulu, Miami, Seattle, San Francisco, and Portland, Oregon. Fringe parking lots have been established in many cities to serve carpoolers and express buses, and experience has been evaluated in Connecticut, Missouri and Utah. The U.S. Federal Highway Administration plans to continue to monitor current projects and some of those which have been recently implemented. Emphasis during the next few years will shift from isolated projects on freeways, urban arterials, and city streets, to the creation and management of systems for preferential treatment of high-occupancy vehicles.

Observations

The bus priority concept is still relatively new in the U.S. The first reserved freeway bus lane -- Shirley Highway project -- began operation in 1968. Recent activity in priority programs for high-occupancy vehicles date from programs initiated as a result of the environmental and energy legislation, and the related shift in Department of Transportation policy to emphasize management-oriented as opposed to capital-oriented solutions (see Appendix B).

U.S. experience confirms European findings that substantial traveltime savings may be achieved by schemes to give priority to high-occupancy vehicles, particularly during the peak hours. In most cases, autos can be accommodated along with buses provided that an effective rationing device is employed to limit the number of vehicles (e.g., a minimum of two persons per car in Los Angeles but four on the Shirley express lanes). Except where barriers are utilized or separate lanes are constructed, implementation and operating costs are minimal. However, vigorous enforcement is necessary except for projects which are self-enforcing (i.e., contra-flow schemes).

Schemes must be tailored to fit the unique characteristics of each community and each specific location, and considerable effort must be devoted to advising and educating users about how the system will operate, and to gaining general public acceptance of the concept of giving priority to high-occupancy vehicles. The Santa Monica experience vividly illustrated that it is much more difficult to gain acceptance of schemes which take highway capacity away from motorists, particularly in areas where the automobile is deemed a necessity, where low population densities and dispersed origins and destinations make conventional transit difficult, and where commuters are unfamiliar with express bus service and have difficulty conceiving of comparable, much less reduced, traveltimes by public transportation.

Environmental and energy concerns, increasing opposition to major urban capital programs, disillusionment with rail transit as a widespread answer to urban travel needs and inflation have contributed to much greater emphasis on bus priority and other high-occupancy vehicle programs in the U.S. Attention is now being directed to comprehensive systems for high-occupancy vehicles similar to those which have performed so successfully in England, France and Canada.

URBAN GOODS MOVEMENT

Lead Country: France

Participating Countries: United States, United Kingdom, Germany

1975 Report

The CCMS Urban Goods Movement Project examined problems created by the movement of freight in urban areas, particularly "LTL" (less-than-truck-load) shipments. The report reviewed the characteristics of freight activities which are essential to understanding UGM and to developing strategies to improve the efficiency of freight movements. It also reviewed a number of alternatives which have been proposed to improve physical distribution in cities and to better integrate freight movements with other transportation and economic activities. The report noted that freight transport and particularly truck traffic are essential to urban life and therefore must be provided for. Moreover, existing UGM patterns and practices provide substantial benefits to shippers and receivers: changes proposed to existing systems must be carefully weighed in terms of the potential impacts on the principal actors in the freight sector as well as the anticipated benefits to the community at large. The reality of the "service first" philosophy and its implications were underscored (i.e., the fact that freight transport constitutes a relatively small share of the total costs to retailers and that shippers and receivers are willing to pay higher rates for prompt service, advertisements on the vehicles, arranged displays, credit, insurance and inventory maintenance).

The report was organized around the following topics (see Appendix A-4):

Traffic problems -- the nature of UGM, different perceptions of "the problem", differences and similarities among cities in the CCMS countries, and different priorities with respect to public policy.

Technical problems -- issues related to the design of trucks, loading bays in buildings, and physical distribution procedures.

Freight terminals -- the tendency to use streets and sidewalks to serve as terminals, i.e., as sites for breaking bulk, consolidating, loading and unloading, rather than using special facilities to organize shipments according to route and destination in order to reduce the number of truck trips, alleviate congestion, and lower distribution costs.

Regulation and Commercial Use, Planning -- the distinguishing features of freight movements, including UGM as an explicit

consideration in land use and transportation planning, and the need for greater standardization of road signs and coordination of hour of operation between CCMS members and their trading partners.

Demonstration of New Projects -- a range of alternatives for improving UGM efficiency in the near-term (e.g., rescheduling pickup and delivery, and greater use of prepaid shipments, the intermediate-term (e.g., consolidated pickup-and-delivery and improved documentation), and the long-term (e.g., changing design of equipment and facilities, and technological innovation).

The report revealed many common UGM practices and problems. However, because of different social attitudes in the different countries, and differences in the way commercial vehicles are treated in towns, perceptions of the problems and the priorities differ. Each participant felt that the account he had given of his own problems and his own work would be of value to other nations. However, there were some reservations concerning how far detailed experience or policy recommendations could be directly transferred from one country to another.

The report recommended additional research, demonstration, and cooperation in UGM among CCMS members, particularly in view of the increasing awareness of the problems associated with freight movements in cities, and the comparatively little attention the subject has received to date.

Present Status and Recent Developments

In 1973-74 the NATO/CCMS Urban Transportation Project report was the only forum in which research workers concerned with urban freight movement could communicate on an international basis. There were indeed relatively few of them. Since then, interest in the topic has grown. ECMT held a Round Table (No. 3) on this topic in 1975 (Freight Collection and Delivery in Urban Areas). The OECD Road Research Committee held a seminar on UGM in 1977 concerned with the management of urban freight distribution in ten nations. This group is expected to produce a state-of-the-art report and recommendations during 1978.

In the intervening period, the amount of research work on urban goods movement has increased very considerably, particularly in the U.S. The reports of the Second and Third Engineering Foundation

Conference on Goods Transportation in Urban Areas describe projects and experiences too numerous to be listed here. The U.S. DOT has addressed a number of particular areas and the general problem of urban goods movement in cities and its relation to the general transportation planning process. This material has been made widely available both through general circulation procedures and through bilateral relationships with other nations.

In both France and Britain, on the other hand, nationally organized research activity in this area has tended to diminish. This is no doubt partly because in both cases the national institutions started work in the area before the United States, and the initiative has now passed to departments, counties, and municipalities to attack what is known and to extend it as befits their special needs. There has indeed been a considerable degree of regulatory activity and investment at local levels. London, in particular, has a substantial research and implementation activity, and has some direct if informal links both with national research organizations overseas and with other overseas municipalities.

In Great Britain, the large projects to investigate the distribution of commodity movements and the potential costs of urban goods movement regulation in Swindon and Hull are complete, and were reported at a seminar given at TRRL in 1977. An earlier seminar, in 1975, reported a series of smaller studies of the potential impact, in both environmental and cost terms, of possible regulations affecting heavy commercial vehicles. The government-encouraged, industry-based Lorries and the Environment Committee continues to investigate means of reducing the environmental impact of lorry movements--it has recently reported on transshipment (1976), freight complexes (1977) and direct distribution techniques (1977). It is perhaps worth mentioning that these studies have suggested that all-purpose, municipally controlled transshipment centers are not cost-effective.

In the circumstances where the volume of the research activity is taking place within local government--and this appears to be the case in Canada, Germany and Japan, as well as in the countries already mentioned--it is extremely difficult to judge what impact the research work already carried out is having. The OECD project and the international flavor of the Third Engineering Foundation Conference suggest that the paucity of reliable information is still such that research reports and experience from many sources are eagerly sought out. for purposes of implementation, however, local considerations are the determining factor in choosing among alternatives. This is illustrated by the example of Paris, which finds it politically desirable to adopt a strategy of regulating the movement of goods, in agreement with industries concerned, on a commodity-by-commodity basis.

Gross Measurements. Studies recently completed for the U.S. DOT have contributed to a better understanding of UGM.[5,6] The following picture has emerged:

UGM Costs. In 1972, trucks accounted for nearly 90 percent ($51 billion) of the $57 billion spent on UGM, automobile operating costs accounting for the remainder. Thus, the cost of goods movement within cities is substantially greater than intercity truck, rail, air or water expenditures individually, and is nearly as large as all intercity freight transport combined.

Trends. UGM costs have been increasing faster than virtually all other transportation activities, particularly intercity trucking.

Characteristics of UGM. UGM haulers are primarily divisions or departments of business whose prime concern is not the transport of freight, but the manufacture or selling of products and services. The receivers of freight consignments are small, and most truck fleets consist of 20 or fewer units. While direct pickup and delivery of intercity freight represents nearly 45 percent of the tonnage, it requires less than 1 percent of the stops and accounts for only about 7 percent of all intracity goods movement miles. But for intracity freight services, which make up only 12 percent of the tonnage, require 80 percent of the stops and 31 percent of the miles. Similarly, food accounts for only 5 percent of the tonnage but 28 percent of the miles traveled.

UGM Impacts. Table 1 summarizes the impacts of UGM on the urban environment (it does not include local goods movement in smaller cities or rural areas). While UGM activity creates significant problems in certain locations, it contributes relatively little to air pollution and to land use when averaged over the 248 largest urbanized areas. However, the urban goods movement share of total goods movement cost, congestion and energy consumption are much larger than previously had been supposed. These findings make it difficult to justify so little attention to freight in cities.

Data related to UGM costs, trends and impacts in other countries reveal striking similarities among cities all over the world.

Developments in UGM Planning. While there have been only a few attempts in the U.S. to plan for freight movements in specific cities, there has been some effort recently to develop UGM planning as a separate discipline. The DOT study cited earlier constructed a taxonomy to relate the impacts of UGM to their

TABLE 1

Summary of Urban Goods Movement Impacts (Annual)

	Total	Urban Goods Movement (1)	Percent of Total
Goods Movement Cost ($ Millions)	$119,909	$41,612	34.7%
Congestion (Total Travel Hours in Urbanized Areas–Millions)	9,193	1,287 (2)	14.0
Transportation Energy Consumption (Millions of Gallons of Fuel)	149,680	9,302	6.2
Air Pollution (Millions of Tons)			
Carbon Monoxide	101	4	4.1
Hydrocarbons	31	1	2.3
Nitrogen Oxide	23	–	1.1
Sulfur Dioxide	33	–	0.1
Particulates	21	–	0.1
Land Use (Square Miles)	35,080	200	0.6

Notes: (1) 248 largest urbanized areas only.
(2) Hours of travel to be saved if all trucks removed from traffic stream.

principal causes (Table 2). Somewhat surprising is that "stem" truck travel (the daily round trip from the garage or terminal to the delivery route and back) is a major contributor to traffic congestion, and that the number of truck stops, vehicle maintenance practices, and goods movements by automobiles have significant impacts on energy consumption and air pollution. A Department of Transportation (DOT) study aimed at developing methodology for short-range UGM planning found that physical constraints such as telephone and light poles situated at curbsides on narrow streets and intersections and failure to provide off-street loading and unloading facilities (or providing bays which are too small or the improper height to accommodate many of the vehicles) are major causes of traffic delays and other UGM impacts.[7] Similar conclusions have been reached in the United Kingdom, Australia and Canada.

Short-range Strategies. In keeping with the recent US emphasis on making more efficient use of existing transportation systems, the following types of strategies are being proposed:[8]

1. TRANSPORTATION-ORIENTED STRATEGIES TO IMPROVE MOVEMENT OF PEOPLE AND GOODS

   - Traffic operations improvements
   - Enforcement of existing regulations on parking, standing, turning
   - Measures to reduce peaking
   - Measures to reduce travel during peaks in congested areas.

2. TRANSPORTATION-ORIENTED STRATEGIES TO FACILITATE TRUCK OPERATIONS

   - Reexamination of mail pickup sites
   - Curb cuts
   - Clearing corners of parked vehicles
   - Reducing obstacles to trucks at curbsides, corners

3. MANAGEMENT-ORIENTED STRATEGIES TO IMPROVE EFFICIENCY OF UGM

   - Prepaid shipments
   - Simplified documentation
   - Better scheduling of pickup and delivery times
   - Better route engineering by computers, cost-effectiveness
   - Increase delivery lot sizes
   - Freight consolidation, coordinated pickup-and-delivery
   - Better use of containers
   - Increased use of taxicabs for pickup-and delivery while "cruising"
   - Vehicles no larger than required for operations
   - Loading dock and elevator changes
   - Substitution of truck trips for some types of automobile trips.

TABLE 2

Causes and Effects of Urban Goods Movement Problems[1]

Causes	Fundamental Effect on:						Secondary Effect on:					
	Costs	Congestion	Energy Consumption	Air Pollution	Noise Pollution	Land Use	Costs	Congestion	Energy Consumption	Air Pollution	Noise Pollution	Land Use
Number of Stops	X		X	X								
Number of Routes	X											
Number of Helpers	X											
Vehicle Cost (per mile)							X					
Inefficient Terminal Configuration							X					
Institutional Operating Restrictions: Government, Union, and Tradition							X					
Underutilization of Technology: Management, Handling							X					
Stem Driving During Peak Hours		X										
Lane Blockage on Arterials		X										
Improper Matching of Receiving Facilities to Needs		X										
Large Trucks								X		X		
Number of Auto Shopping Trips			X	X								
Excess Vehicle Capacity (relative to load)									X			
Low Speeds, Stop and Start Traffic Conditions									X	X	X	
Inappropriate or Improperly Maintained Engine or Exhaust Systems									X	X	X	
Congestion									X	X		
Use of Trucks with High Noise Emission for Urban Goods Movements					X							
Closeness of Noise Source to Receiver											X	
Suboptimal Land Use Decisions						X						
Gradualism of change												X

It should be noted that pricing measures aimed at increasing the price of movement in congested areas, particularly during peak periods, would serve as catalysts for most strategies.

Most of these measures have also been proposed by the other CCMS members.

New York Garment Center Project. The Garment Center Project was undertaken to develop strategies to improve the movement of both people and goods in New York City's Garment Area, and to produce methodologies which would be applicable to other cities as well.[9] The Study evaluated a number of short-range alternatives with respect to their likely impacts and constraints (see Table 3), and chose the following for implementation:

- passenger vehicles ban
- designation of truck turning lanes
- restrictions on pedestrians
- reduction in truck parking duration
- corner curb cuts (to facilitate clothing racks)
- mid-block curb cuts (to reduce activity at intersections).

While encouraging results were achieved initially in 1975, New York City's financial difficulties have delayed the program. Recommendations for long-range improvements include changes in the design of clothing racks, vehicles, and receiving facilities, greater use of consolidation, and a number of changes which may be grouped under the heading of physical distribution management.

Allocation of Curb Parking Space. The effects of alternative downtown land uses on commodity flows and on the demand for space to pickup and deliver freight were examined in yet another DOT study.[10] The study suggests that it is possible to predict the number of weekly truck trips a building or an entire city block will generate by developing indices relating the number of truck trips to each type of activity. With knowledge of the number of pickup-and-delivery hours, the weekly figures can be translated into daily estimates of the demand for loading and unloading space. The study considered a number of alternative strategies, and concluded that measures to reduce the peaking of pickup-and-delivery operations, and schemes to ration curb space among competing users offered the most promise for the study site, a square block in downtown Brooklyn.

United Kingdom. The Greater London Council recently completed a a study titled Freight in London.[11] The recommended "Overall Strategy" was summarized as follows:

Table 3

SYSTEMS CRITERIA FOR THE EVALUATION OF SHORT-RANGE LOW CAPITAL IMPROVEMENTS

SYSTEMS CRITERIA			ALTERNATIVE												
			Passenger Vehicle Ban	Turning Lanes	Restrict Pedestrian Crossings	New Parking Regulations	Corner Curb Cuts	Mid-block Curb Cuts	Off-Hour POED	Street Widening	Special Handcart Lanes on Streets and/or Avenues	Overnight Off-Street Parking	"No Standing" On One Curbline	Parking Reservation System
OBJECTIVE			Reduce Congestion	Improve Traffic Flow	Expedite Traffic Movement	Expedite Traffic Movement	Reduce Vehicle-Pedestrian Conflict	Reduce Vehicle-Pedestrian Conflict	Reduce Congestion	Improve Traffic Flow	Reduce Vehicle-Pedestrian Conflict	Improve Carge/Vehicle Security	Expedite Traffic Movement	Increase Utilization of Curb Space
POLITICAL FEASIBILITY			?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ADMINISTRATIVE FEASIBILITY			?	?	?	Yes	?	Yes	Yes	Yes	?	Yes	Yes	?
IMPLEMENTATION COST	PRIVATE SECTOR		low	low	low	low	low	low	mod	mod	low	mod	low	mod
	PUBLIC SECTOR		low	none	none	none	low	low	low	mod	low	low	none	mod
IMPLEMENTATION TIME (MONTHS)			3 to 6	1 to 3	1 to 3	1 to 3	3 to 6	3 to 6	6 to 12	6 to 12	1 to 3	6 to 12	1 to 3	6 to 12
APPLICABILITY TO OTHER AREAS			Yes	Yes	Yes	Yes	No	No	Yes	Ltd.	No	No	Yes	Yes
OPERATIONAL INNOVATION			No	No	No	No	No	No	No	No	No	No	No	Yes
INSTITUTIONAL CHANGES			No	No	No	No	No	No	Yes	No	No	Yes	No	Yes
BENEFITS/COSTS	PUBLIC	AIR/NOISE POLLUTION	+	+	0	?	0	0	+	?	0	0	+	?
		STREET MAINTENANCE	+	+	0	?	0	0	0	0	0	0	0	?
		PEDESTRIAN CONFLICTS	+	0	+	0	+	+	+	-	+	0	0	0
		MASS TRANSIT CONFLICTS	+	+	0	0	+	0	+	0	+	0	0	+
	PRIVATE	TRUCKER	+	+	+	?	+	0	+	+	+	+	+	?
		HANDCART PUSHER	+	0	0	0	+	+	0	-	+	0	0	0
		CONSUMER	+	0	0	0	+	0	+	+	+	+	?	+
		SHIPPER	+	0	0	0	+	0	+	+	+	+	?	+
	OTHERS	GARAGE OPERATOR	-	0	0	0	0	0	0	0	0	+	0	0
		BUILDING OPERATOR	0	0	0	0	0	0	-	-	0	0	0	0

OVERALL STRATEGY

The policies set out individually in the report come together as a comprehensive strategy. As far as possible, improved facilities are proposed in parallel with restrictions and the policies for freight developments are tied in with those for industry and the transport infrastructure.

This total policy should reduce operating costs and substantially reduce the flows of very large lorries on sensitive routes. It would also significantly reduce the noise level and reduce other problems deriving from such vehicles. This appears to be a worthwhile objective warranting general support from all interests.

European Conference of Ministers of Transport. The recent ECMT Freight Collection and Delivery in Urban Areas[12] surveyed the characteristics of freight traffic and related problems in European cities, and concluded the following:

> In order to solve the difficulties with freight traffic in towns, it is essential to strengthen cooperation between the enterprises concerned and the public authorities, because this traffic operates within a closed system depending on:
>
> - the goods to be transported
> - land use
> - transport infrastructure.

The following possible courses of actions were proposed, depending on the particular local freight problems and the institutional setting:

1. Regulatory Measures
   - controls on parking of delivery vehicles
   - controls on through traffic (particularly for medium-sized towns);
2. Changing Distribution Practices
   - changes in marketing (particularly cooperation in storage and delivery of small shipments)
   - changes in carrier trade (particularly substitution of for hire for private transport); and

3. Long-term Measures

- technological change (particularly development of pallets and containers, and increased mechanization of warehouse operations)

- creation of new infrastructure (particularly underground freight tunnels, off-street parking, and ring roads)

- physical planning (particularly giving greater attention to freight-generated characteristics of different land uses, e.g., terminals).

It is interesting to note that pneumatic tubes already are used to centralize refuse collection in apartment complexes in Sweden, and more recently, in the U.S.

Large volumes of cargo are being handled in a system used at Charles DeGaulle Airport and in Rouen, France, and in Järna, Sweden. The system revolves around three principles: first, that shipments destined to the same location can be placed in common containers; second, that these containers can be routed automatically; and third, that the normal tunnels carrying other urban servicing can also be used to carry freight. The options for such a system in the future are many and varied. For example, applications in addition to cargo routing and sorting at an airport could include installation in a new town, in industrial parks, or connection of consolidation terminals around a CBD area.

Organization for Economic Cooperation and Development. The OECD Research Group UTI Project, "Management of Urban Freight Distribution," compares the approaches to planning for the transport of freight in cities, and the strategies which are being developed in Western Europe and North America. This is the first attempt to comprehensively examine UGM on an international basis. Since the report is rather large and will be available later this year, no attempt will be made to describe it here.

OBSERVATIONS

Studies, demonstrations, and experience in CCMS countries, in Japan, and in the U.S.S.R. support the hypothesis that impressive benefits in terms of distribution costs, traveltime, energy use, and in certain locations, urban amenities, noise and air pollution can be achieved by more efficient transport and handling of freight in cities. Because the costs of freight movements do not appear as separate items on the bills and price tags presented to the general public, the costs of inefficient UGM practices and techniques normally go unnoticed. In large cities, however, the distribution costs are frequently high enough to offset some of the economies of urban agglomeration. It is perhaps significant,

in view of New York City's financial situation, that interstate carriers impose a surcharge for picking up and delivering in the City.

The growing interest in UGM in U.S. cities coincides with the shift in emphasis during the 1970's to management-oriented as opposed to capital-oriented strategies to cope with growing concerns over air quality, energy use, and urban traffic problems. The most recent stimulus in the U.S. came from the Transportation System Management (TSM) regulations issued by DOT in 1975 (Appendix B). Planners with the responsibility to implement local TSM programs have begun to realize that vehicles transporting freight <u>are</u> part of the urban transportation system, and that the system cannot be managed <u>more</u> efficiently unless freight activities are taken into account.

A number of U.S. projects are in or near final stages, and the findings and lessons from these projects will soon be available to other CCMS members, particularly the work related to impact assessment, short-range, management-oriented UGM planning, and the New Yrok Garment Center Project. The U.S. could profit greatly from learning more of recent work in the Netherlands concerned with the design and implementation of consolidation strategies (particularly the work at the Netherlands Institute of Transport), French efforts to reduce conflicts between passenger and freight activities in the downtown and to design vehicles better suited to urban operation, and British experience in modeling freight flows and terminal operations in Swindon, analyses of the cost of light vehicles, the freight work of the Greater London Council, and the methods employed to achieve greater cooperation and coordination between government and the private sector, particularly the carriers.

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SHORT-DISTANCE TRANSPORT TECHNIQUES

Lead Country: Federal Republic of Germany

Participating Countries: Canada, United States, United Kingdom, France, The Netherlands, Belgium, Italy

1976 Report

Short-Distance Transport Techniques, CCMS Report No. 57, examined a spectrum of urban transportation vehicles and system operating in 1975 or expected to be operating by 1980 (see Appendix A-5). The usual criteria were recommended for evaluating various alternatives (e.g., benefit-cost analysis, performance, energy consumption, environmental impacts, and public acceptance). However, no vigorous analyses and comparisons were attempted because of problems of currency exchange rates, and recognition of the impossibility of reaching agreement on the values to assign to the costs and benefits which are always difficult to quantify (e.g., the value of traveltime).

The report described a number of alternatives individual CCMS countries were considering in 1974-75, particularly exclusive and fixed guideway systems. It concluded that if public transport is to be a serious alternative to the private automobile, it must meet certain standards with respect to traveltime, comfort, and frequency which are found on only a few public transportation systems today.

The recommendations may be summarized as follows:

- better operation and integration of existing systems;
- the savings in traveltime from separate rights-of-way should be balanced against the very high costs of these systems;
- greater attention should be given to potential of the bus to provide innovative services, particularly when integrated with paratransit; and
- much greater use should be made of cost-benefit analysis, including explicit treatment of non-quantifiables (e.g., air pollution).

Present Status and Recent Developments

Since the report was completed in 1975, urban transportation policy in less developed countries as well as in Europe, North America and the Far East has shifted toward an emphasis on management and operational strategies to improve urban transportation performance. Simultaneously, there has been a lowering

of expectations concerning what may be accomplished by large-scale, capital-intensive rail transit and highway programs. This change in emphasis is exemplified by the OECD Conference "Better Towns With Less Traffic" of April 1975, and the Transportation System Management (TSM) program announced by the U.S. DOT in September of the same year (Appendix B). These developments are in keeping with the first recommendation cited above:

- better operation and integration of existing systems.

European Developments. Examples of the change in emphasis in urban transportation policy include the following:

1. OECD activities.

   a. The participants at the OECD Conference " Better Towns With Less Traffic" reported a wide variety of innovations in bus services, paratransit, vehicle restriction schemes, programs to facilitate bicycle and pedestrian travel, traffic operations, parking restrictions and work schedule changes.

   b. As a followup to "Better Towns With Less Traffic", OECD is organizing a 1979 meeting "Urban Transportation Innovation", which will bring together local planners and elected officials to discuss implementation of management and operation-oriented strategies.

   c. OECD has organized a number of research projects concerned with specific sets of strategies, e.g., urban freight distribution, transportation in low density areas, and traffic management.

2. In the region of Flensborg, Denmark, a "Timed Transfer" system has been implemented. Fixed-route, fixed-schedule buses meet at major activity centers to permit transfers within five minutes or less. A number of towns are interconnected by the system, and maps and schedules are available to facilitate travel from one town to another. The sytem is also employed in Vancouver and in Edmonton, Canada. In Edmonton, the system has been particularly well received.

3. "Self service" fare collection has been employed in Holland for some time. The practice has spread to Germany, Ireland, and Switzerland, and is now being marketed in the U.S.

4. During the last two years, an overall policy has been implemented in Paris in an attempt to reverse the growth in auto congestion and the decline in transit use by modifying the road infrastructure, the public transport systems, and parking facilities, the rate schedules of which make it possible to reduce the number of automobiles in the city.

The land use plan helps to control traffic by organizing the use of urban space and is allowing traffic to move faster by providing major traffic improvements including overpasses and underpasses. The plan also includes construction of new parking places, recovery of pedestrian areas, and control of on-street parking by installation of meters and time no-parking zones.

Parking on residential streets, for which residents pay reduced rates, will increase the traffic capacity of heavily traveled streets. Public authorities will have the option of building residential garages, retaining existing commercial garages, building parking facilities on private ground, or creating "mini parking lots" on public streets for residents. The pattern of parking will deliberately direct the commuting suburbanite to the outlying parking lots at the entrances to Paris. The plan includes:

1) Local increases in capacity and one-way streets and traffic lights in peripheral zones with substantial transit, facilitating the flow of traffic coming from the major arteries and the Peripheral Boulevard;

2) Public transport and pedestrian preference in the central saturated zone, through a coherent parking policy;

3) Entry control, incident detection, and surveillance on the Peripheral Boulevard;

4) Enhanced safety through improvements in lighting, traffic signs and markings, pavements surfaces, and pedestrian protection;

5) Restructuring of the bus network by increasing the exclusive bus lanes to cut traveltimes; and

6) Improvement of the environment by surfacing, landscaping, planting, and lighting pedestrian areas.

5. In the spring of 1976, plans were finalized for a joint U.S./German study of the Cabintaxi/Cabinlift Automated Guideway Transit (AGT) technology under development in the Federal Republic of Germany. This project was initiated under an agreement between the German Federal Ministry of Research and Technology (MORT) and the United States Department of Transportation. The agreement calls for cooperation in the assessment of AGT technologies in order to guide further research, development, demonstration, and deployment decisions relative to AGT.

   The Cabintaxi/Cabinlift systems differ from the other AGT systems currently being studied under UMTA's Assessment Program in two significant ways:

   a. These systems have not been conceived and designed for a particular transportation need at a specific site. Cabintaxi/Cabinlift represents a modular concept: a set of components and operational modes which are being developed as building blocks to suit a variety of applications.

   b. The systems are still evolving; most of the individual components have reached a high level of maturity, while the technical development of others is just beginning. A Cabintaxi/Cabinlift system has not yet been deployed for use by the general public except for a simple, single-vehicle shuttle system in Ziegenhain, Germany. The latter point reflects the German approach to fielding of new systems, which is characterized by an extensive and lengthy development period to refine the design of individual components in order to reduce the risks associated with implementation. The present Cabintaxi/Cabinlift technology is the result of an iterative design process which began in 1969 and has been greatly aided by the use of a large and sophisticated test facility in Hagen since 1973.

      The system presently boasts three types of vehicles: a three-passenger vehicle (KK3), a twelve-passenger vehicle (KK12), both accommodating seated passengers only, and a Cabinlift vehicle, which is a slightly larger cargo or passenger vehicle whose height will accommodate standees. The three basic vehicle types of different physical dimensions are associated with particular operational strategies, and thus a specific class of applications as shown in the following table.

	Physical Dimensions			Operational Strategies
	Length (m)	Width (m)	Height (m)	
KK3	2.0	1.7	1.6	Destination Discretionary (Personal Rapid Transit (PRT) - Demand mode)
KK12	4.8	1.7	1.6	Line Transport (Scheduled mode) or mixed Scheduled and Demand mode
Cabinlift	3.94	2.44	2.40	Line Transport (Scheduled mode) or mixed Scheduled and Demand mode

6. An on-line, "mini-metro" automated system constructed by VAL now links Lille, France to a satellite "new town." VEC has constructed a downtown people mover (DPM) in Paris to facilitate access from a parking lot to a department store. An ARAMIS off-line advanced group rapid transit (AGRT) system now serves Orly Airport and has facilitated passenger transfers between airlines. A "POMA 2000" cable car is in the developmental stage in Grenoble. It is intended to facilitate movements in Laon, a town northeast of Paris where growth has occurred at two different elevations over eight centuries.

7. In Sweden, Volvo and Saab have produced prototype taxicabs which offer accessibility to wheelchairs. Both firms presently are attempting to market the vehicles.

U.S. Developments. The shift in urban transportation policy toward Transportation System Management (TSM) alternatives has already been noted. The rapidly rising construction and operating costs of rail transit systems and their failure to attract the numbers of automobile users which had been anticipated have brought about discernible changes in public attitudes toward rail transit. The recent finding of the Congressional Budget Office that rail transit is less energy-efficient than bus transit appears to have exacerbated what the public sees as a credibility gap with respect to rail transit.

Cities applying to the DOT Urban Mass Transportation Administration for capital funds to construct rail transit now are required to undertake an analysis of alternatives to determine whether there are more cost-effective ways to achieving the desired levels of service. The applicant must also explain how operating costs are to be covered.

Among the current research, development and demonstration projects sponsored and funded by UMTA, the following are regarded as particularly important in the present TSM or management-oriented approach to improving urban transportation performance, improving the quality of the environment, and conserving fuel.

1. Design of a Modern 40-Foot Transit Bus (TRANSBUS)
2. Small Bus Requirements, Concepts and Specifications
3. Evaluation of a Hybrid Diesel/Electric Bus
4. Low Pollution Paratransit Vehicle
5. Flywheel Energy Storage Systems
6. Evaluation of Diesel Propulsion in Fleet Taxicabs
7. Automatic Vehicle Monitoring (AVM) and Communication Systems
8. Dial-a-ride systems integration of paratransit with Conventional Transit
9. Corridor Improvements in Houston, Texas
10. Auto Restricted Zone/Multi-user Vehicle Systems Study
11. Coordinated Paratransit Service Demonstration Project
12. Nassau County Shared Taxi Demonstration
13. Taxicab Feeder to Bus Service

14. Feasibility Study of Multiple Trip Subscription Bus Service

15. Community-based Jitney Service

16. Special Elderly and Handicapped Services for a Medium-sized City

17. Congestion Pricing

18. User-side Subsidy Demonstration

19. Double Deck Bus

20. Transportation Systems Management Element Guideline Review

21. Light Rail Vehicles and Systems Standardization

22. Study of Methods of Improving LRT Service

23. Demonstration of Downtown People Mover (DPM) in selected cities

24. Development and testing of prototype Advanced Group Rapid Transit System (AGRTS)

Observations

In Europe, North America, Japan, and in the larger cities of the developing nations, public transportation has steadily lost ground to the private automobile, especially since World War II. The trends which portrayed a scenario considered at one time to be unique to the U.S. now are common in cities in most countries today: rising personal incomes (frequently accompanied by purchase or rental of housing in low-density areas); rising per capita auto ownership; growing use of the automobile for personal travel in urban areas, and concomitant growth in congestion and interference with public transportation also using urban streets; damage to the environment; decentralization of economic activities; declining transit ridership and revenues; increases in public expenditures to maintain conventional transit services; increased financial burdens for the public sector; and growing frustration--if not despair -- among citizens, elected officials and planners over the apparently intractable nature of the urban transportation problem. In Europe, at least, the differences vis-a-vis the U.S. are a matter of degree rather than of kind, and European cities appear to be rapidly closing the distance which separates their difficulties from those of their counterparts in North America.

The present picture is a reversal of the relative positions in the 19th and early 20th centuries. The horse-drawn omnibus, the

horse-drawn tram, the streetcar, and subway and even the automobile were first introduced in Europe and later imported to the U.S. Today, the flow of paratransit research results and innovative ideas from North America to Europe appears to be larger than the flow from Europe to North America. However, European cities have not let their public transportation systems deteriorate to the level of the systems in the U.S. Because Europe has maintained and upgraded its systems, it leads in bus and rail (particularly light rail) technology. Moreover, it recently has pioneered in a number of areas, for example, flexi-time, automated fare systems, transit integration, and in the use of comprehensive bus-priority schemes.

The recent emphasis on transportation system management on both sides of the Atlantic opens many possibilities for fruitful cooperation and joint efforts in pursuit of the common goal of transportation systems which enhance: the choices and opportunities available to individuals, the efficiency of the urban economy, and the quality of the urban environment.

APPENDIX A

SUMMARY AND RECOMMENDATIONS OF CCMS URBAN TRANSPORTATION PILOT STUDIES

SUMMARY AND RECOMMENDATIONS

of the

CCMS/NATO PROJECT: URBAN TRAVEL FORECASTING

BACKGROUND

This subproject is one of five problem areas in urban transportation that are being studied under the North Atlantic Treaty Organization/Committee on the Challenges of Modern Society (NATO/CCMS) Urban Transportation Pilot Study. Since its inception a number of pilot projects have been undertaken cooperatively by NATO allies, all aimed at various areas of social and environmental concern. Urban transportation as a new area of investigation was introduced by the United States at a 1971 NATO/CCMS Plenary Session and specific proposals made at the 1972 Spring Plenary. In September of that year a committee of experts was convened to consider five possible subprojects which were presented to the North Atlantic Council at the Fall 1972 Plenary. The Council approved the Urban Transportation Pilot Study in December 1972.

As with other projects under the NATO/CCMS sponsorship, this study was chosen because of its potential for being directly useful to governments and policymakers facing difficult decisions regarding alternative transportation investments. The project relies extensively on recent and existing knowledge and readily available data sets for analysis purposes. In addition a finite project duration could be achieved.

THE CURRENT PROBLEM

Public officials and decisionmakers are more and more often being required to evaluate alternative courses of action and investment dealing with transportation services. The economic and social implications of such actions demand that the decisionmaker have at hand the best and most efficient tools to aid him in making those decisions. The manifold facets and complexities of urban growth in recent years have made the transportation planner and analyst's job of providing those tools, and the resulting information, to the decisionmaker overly difficult.

Until recently the planner has had to respond to questions about the rate and direction of growth in the demand for transport services. This has generally been in an environment when growth

has been viewed as an unmitigated good. More recently, however, attitudes toward growth and uncontrolled urban expansion have drastically changed and have become a subject of international concern. Consequently, the questions that officials are asking of the planners and forecasters today have changed. More often than not, today's urban transportation planner is being asked to determine the consequences of not making a certain transportation investment rather than to determine what investments need to be made to meet the otherwise unconstrained demand for transport services.

There is another situation which gives particular emphasis to this project. By simplifying and achieving a degree of standardization in travel estimation procedures, benefits could accrue to the user nations in the form of time and cost savings as well as broadening the spectrum of conditions under which the forecasting procedure can be expected to operate. The first benefit could result from the application of a less sophisticated, and therefore less costly, forecasting procedure. The latter benefit could result in a cross fertilization of knowledge regarding the consequences of various policy decisions.

In the data on which this report is based it can be seen that the relative position of the various countries in terms of the economic/travel interrelationship is seen as an indication for the need to assess alternative courses of action. European countries have limited the use of private autos through such things as taxing, pricing and land use policies discussed earlier. The U.S. is now facing a similar situation regarding policies for the limitation of travel. At the same time the use of the private automobile is growing in European nations and particularly in urban regions. Under these circumstances the experiences of nations on both sides of the Atlantic can be beneficial in examining alternative courses of action.

OBJECTIVES OF THE SUBPROJECT

Because of the many and rapid changes in urban growth and travel taking place today, decisionmakers are interested in the effects of alternative policies relating to variations in auto use with changing economic levels. The objective of this project was to provide guides for public officials in developing estimates of future travel likely to materialize if existing trends were allowed to continue. Because of urban development by Europe and the U.S., it is advantageous to draw on the experiences of each as analogies of what might happen under existing trends. Specifically, the goal was to provide a simpler, less costly, generalized urban travel forecasting procedure to provide quick information on the future growth patterns of urban travel.

In a somewhat broader sense, there were several aspects of the subproject which were intended to provide some enhancement to the state-of-the-art of travel forecasting. These were: (1) An exchange of knowledge and data on trip generation characteristics under varying social, economic, and demographic conditions; (2) investigation of the possible commonality of trip generation relationships on an international scale; (3) extend the knowledge of household trip generation analysis using cross-classification or category analysis and thereby enhance its use as a simpler, less costly forecasting tool. While the use of existing data and information was not an objective, it was a premise on which the CCMS project was based. Thus existing data sets from home interview surveys in several cities in each of the participating nations were utilized in this study.

SUMMARY OF THE RESULTS

The curves in general follow preconceived notions about differences between European and U.S. characteristics and levels of auto ownership and trip making. The European curves tend to be foreshortened, not extending over the range of income values that the U.S. cities do, generally reflecting lower relative income levels. Single car households in the European cities are higher and multiple-car households are lower as a percent of total households at a given income level when compared to U.S. city data. When family size is introduced as a third independent variable the difference is not quite as pronounced in the larger families. In the single-person households, auto ownership (a single car) is much higher in the European cities analyzed than in the U.S. and the incidence of owning a car occurred over a much narrower, and lower, income range. It would seem that the single-person households contribute most to the differences in auto ownership.

Trip making generally extends over the same range for single-car-owning households, roughly 6-14 total person trips per household, depending on the income level. Multicar households vary a little more, ranging from about 12 to 20 trips per household for one group of cities (both U.S. and European) and from 6 to 14 for another group, again for both U.S. and European cities. The greatest difference between cities is found in the 0-car households which show a relatively high trip rate in Europe when compared to the U.S. curves. This reflects the higher transit trip making in Europe, at least for non-car-owning households. This fact is generally reflected in the curves for percent transit trips by income range which are lower for the U.S. cities. Another difference in the percent transit curve is that it does not vary considerably in trips per household over the range of incomes. At the same time auto trips in the European cities vary considerably over income from about 20 percent to 70-90

percent of total household trips. For the U.S. cities auto trips vary over a narrower range, constituting about 70-80 percent of total trip production over all income levels. On a trip per household basis, however, transit trips for both U.S. and European cities do not vary much at all and for both range from about one to two trips per household on the average.

COMMENTS ON THE SUBPROJECT RESULTS

This subproject explored the generality of travel demand characteristics as viewed from an international perspective. More specifically it tested the ability to develop a generalized trip generation procedure that could be utilized quickly and easily on a multicountry basis to provide information on trip making that would likely occur under varying assumptions of socioeconomic activity. The project results demonstrate a usefulness to decisionmakers, by providing information on potential trip generation activity likely if trends in motorization continue. Experience in European urban areas were contrasted with U.S. conditions both from a national perspective and specifically for the cities analyzed in Phase II. While the cross-classification idea is not new, the specific approach used in this project reflected a definite rationale for trip generation analysis where such has often been lacking in the past in transportation planning from a particular point of view. The specific methodology discussed in this report has been tested and applied under operational transportation planning conditions.

Taken on an individual city by city basis the curves tend to reinforce in a simple and uncomplicated way the underlying concept that auto ownership and socioeconomic status influence the frequency of trip making. Taken collectively, the curves all show the same general pattern of the effects of these two indicators. The fact that the patterns are relatively stable for different countries is notable and the project was successful in identifying this aspect of the relationships.

Additional effects on the curves were discussed and several variables identified as having an influence on the application of the relationships. One of the most important, as might be expected, is the effect of varying economic conditions in the different countries as they affect mobility. Within this broad area, the ability of a consumer (or category of consumers) of transportation or mobility to purchase this commodity is due in large part to that consumer's disposable income.

The development of complex funtional relationships in order to better "fit" the international data sets was not tried. Simple hand fitting of the curves, in a manner suggested for transportation study application, on an individual city basis was done

to explore the patterns of the different relationships. In effect, this proved that the same methodology was applicable across cities in different nations.

More far-reaching and sophisticated (and complex) modeling of travel behavior is being researched and will probably be available in the future. However, the procedure suggested in this project is simple to use and understand and is available now for ready use under conventional travel model constraints with traditional transportation and transportation related data. The procedure thus provides a way of conveniently looking at travel trends and quantifying the effect of alternative trends for practical use.

While the subproject covered only one aspect of the total travel demand picture, this does not mean that other aspects are not as important. It is also clear that there are several immediate and logical extensions that might be made to this specific subproject.

SUMMARY AND RECOMMENDATIONS

of the

NATO/CCMS PROJECT: DEMAND SYSTEMS (DIAL-A-BUS) EVALUATION

Introduction

The CCMS has put Belgium in charge of a study on pick-up on demand systems. The aim of that subproject is to define evaluation methods applicable to a particular type of urban transportation, in this case the Dial-a-Bus System.

The town of Waterloo, 18 miles south of Brussels, was chosen as the site for a study, since its population density, land-use structure, dependence on a major urban center (Brussels) for employment and public transportation make it suitable for an experiment in pick-up on demand.

After consultation with the Waterloo municipal government, two questionnaires (family and individual) were prepared, followed soon after by an opinion questionnaire.

The technical side of the study was entrusted to a specialized organization and was conducted by means of home interviews involving about one family out of five or, to be more precise, 1,271 families.

Procedure

1. Gathering of basic information: The basic information needed for the study was gathered over six weekends in May and June 1974. The public's response to the researchers can be regarded as positive.

2. Transcription of the information: The information was prepared for data processing by transcribing the completed questionnaires onto punch cards.

For purposes of standardizing the transcription, precise coding instructions had been developed so as to cover any particular case that might be encountered.

A control program was developed in conjunction with the coding operation in order to test the replies recorded on the punch cards. That program included validity checks, logic checks, and comparative checks. In addition, the team which prepared the punch cards ran a series of routines designed to gather further information needed for the next step in the study.

3. Information analysis: This operation represents the main part of the study and was also turned over to a specialized organization. The purpose of the analysis is twofold.

First, it must pick out of the mass of information gathered from the inhabitants of Waterloo those items that have significant bearing on the use of a new system; this means that questions drawing few replies are eliminated, those that produce identical information are regrouped, and those not useful for projections are also discarded.

Next, it must estimate potential use and probable use of the pickup on demand system. That involves calculating the travel patterns, especially those of a regular nature, followed by the working and school populations and other groups as well as the probable utilization of the system for the different types of service that it might offer.

The complete analysis comprises four successive stages:

(A) Counting the replies and calculating averages and deviations broken down by type;

(B) Testing statistical reliability by comparing different pairs of variables;

(C) Multi-aspect analysis designed to single out variables that can be regrouped because they produce similar information;

(D) Regression analysis enabling extraction of variables significant for projections of system use.

The study's first objective is to develop an evaluation method making it possible to identify questions that can be discarded or grouped with others, so that proposals can be framed for a more limited questionnaire supplying as much information as the one used at Waterloo.

The second objective is to assemble all pieces of information indicative of potential and probable dial-a-bus use.

The main areas of the study are:

(A) Means of transportation presently being used for different types of travel:

(B) Current work-related, school-related, and other travel patterns.

(C) Declared or estimated probabilities of dial-a-bus use.

Findings Regarding Probable Use

In the light of findings obtained for different types of probable use, regardless of whether failures to reply are taken into account, replies placed in the two favorable categories indicate that probabilities of other use tend to be higher than those of work- or school-related use, and that probabilities of occasional use are much greater than those of regular and frequent use.

In the case of replies placed in the most favorable category, and taking failures to reply into account, a valuable indication emerges: there appear to be two subgroups of probable dial-a bus riders. The first, made up of persons who will use it regularly and frequently for work- or school-related travel, is the group that is very favorable to introduction of the system. The second comprises persons who will use it occasionally for work- or school-related travel; this group is also favorable to the dial-a-bus but shows signs of a wait-and-see attitude.

In every case it is also clear that travel for other purposes attracts at least as many riders as school- and work-related travel.

Comparison of those different figures gives an idea of the potential impact of a campaign to inaugurate and promote the system.

If we wish to evaluate the probability of dial-a-bus use, the findings set forth can be of help to the extent that requirements pertaining to sampling and design of the study have been followed. If it were decided to propose a service for all forms of travel on the assumption that failures to reply express refusal or at least doubt, one could use a figure of 14.7 percent of the sample, translatable into 4,901 daily dial-a-bus rides.

If those figures are compared with the actual operational percentages of the Harlow system and if the coefficients are adapted to the Waterloo situation, the number of daily rides amounts to 2,785. That is far below the study estimates, but it must not be forgotten that the calculations are based on a system as those questioned imagine it, not on a system in operation. At any rate, the fact that 14.7 percent of the sample responded very favorably to the system must not be regarded as an overestimation.

Conclusion and Recommendations

The aim of the study was, on the one hand, to develop an evaluation method for the pickup on demand system and, on the other, to

research potential and probable dial-a-bus use in Waterloo.

In connection with those two aspects, the work group made certain recommendations that it considered indispensable regarding preparation of the questionnaires, research methods, and the value of one or more analyses.

(1) Collaboration with local authorities and the management of the transit company already serving the area must be as complete as possible.

(2) A preliminary study of the city is necessary, even if done in summary fashion.

(3) The sample chosen must be representative of the geographic areas, and those areas must be logically defined and linked. The 20 percent sampling rate used at Waterloo can be regarded as a maximum for urban or suburban areas.

(4) Door-to-door canvassing must be conducted by qualified interviewers who should complete the questionnaires themselves.

(5) The number of questions should be kept as small as possible. They should be simple, concise, and specific. Overlapping questions should be avoided. Observance of those principles will prevent unnecessary and tedious coding and produce illuminating, meaningful, and essential variables.

(6) Door-to-door canvassing should cover two major items: first, a description of the current situation, and second, the collection of information of the attitudes and inclinations of potential users of the proposed system.

(7) Experience acquired operating the system will make it possible to check the validity of the findings. The contribution of this method of analysis by extensive canvassing to future urban and suburban transportation needs must be reviewed annually by the Working Group with respect to the results of the experiments conducted in this field among the countries participating and other interested countries.

SUMMARY AND RECOMMENDATIONS

OF THE

NATO/CCMS PROJECT: BUS PRIORITY SYSTEMS

Bus travel has been the mainstay of public transport for many decades and until about 1950 patronage was increasing in most countries. Since the second World War, however, car ownership in most developed countries has grown at a rate which previously would not have been thought possible, while in parallel with this growth, and partly because of it, a substantial amount of decentralization of industry and suburbanization has taken place. These factors have made public transport services less effective because (a) land-use changes have encouraged a less centrally-oriented pattern of travel, (b) the increasing availability of cars has decreased the demand for public transport, and (c) traffic congestion caused by increased car usage has interfered with efficient operation of the bus services. Consequently, bus travel has become more expensive, feeding the all too familiar spiral of decreased patronage leading to higher fares and less convenient service, which in turn leads to less patronage. There is no doubt that a major cause of the spiral is the increasing use of the private automobile.

A good public transport service, especially in towns, is regarded by many as being a right, just as is the provision of water, sewerage systems, electricity and many other services, and it is difficult to see how most large cities would survive without it. Furthermore, the deterioration in service suffered by bus passengers has occurred through no fault of their own, but simply because other people have preferred to use cars, thus causing congestion and interfering with the bus services. The removal of this hindrance to public transport might well be regarded as a matter of principle, whether or not overall efficiency in the economic sense is improved. But because buses are more efficient users of road space than private cars (a bus may carry twenty times as many passengers as a car, yet it only contributes three times as much to congestion), the freeing of buses from delays caused by other traffic can in many cases produce a net economic benefit. One method of doing this is to give buses priority over other vehicles, by allocating special facilities, and by exempting buses from general traffic restrictions which are detrimental to bus operations.

Though some measures giving buses priority have been in existence for many decades, it was not until about ten years ago that priority schemes began to appear in appreciable numbers and since then the use of such measures has increased enormously. The nature of bus priority has changed over the years from the implementation of simple schemes, for example, a short length of

bus lane or an exemption from a turning prohibition to the use of comprehensive schemes involving wide-scale transportation improvements to whole areas (pedestrianization, traffic engineering measures, road closures and road building) in which improvements to public transport services and the application of bus priority are an integral part of the overall plan.

Bus priority was acknowledged to be a measure of extreme importance by the NATO Committee on the Challenges of Modern Society and was included as one of the five projects in the Urban Transportation Pilot Study which commenced in 1973.

Types of Bus Priority in Common Use

Priority measures include:

With-flow bus lanes (lanes reserved for buses traveling in the same direction as the general traffic)

Contra-flow bus lanes (lanes reserved in a one-way street for buses traveling in the opposite direction to the general traffic)

Reserved bus lanes on freeways (sometimes reversible for tidal-flow operation), priority access to freeways and other facilities (e.g., toll booths)

Bus-only streets

Busways (segregated roads for buses only)

Priority at traffic signals (e.g., automatic adjustment of signal green periods to favor approaching buses, redesign of signal programs in area traffic control schemes to give special weight to bus flows)

Numerous other bus priority measures, including traffic regulations giving priority to buses (for example, when leaving bus stops), parking restrictions near bus stops and on bus routes generally, and traffic management measures specifically applied to bus routes to facilitate the passage of buses

Comprehensive schemes incorporating bus priority and town planning measures

What are the aims of bus priority?

Two fairly obvious aims of bus priority are to restore to buses an operating environment in which buses are free of the hindrance caused by other vehicles and by certain regulations, and to provide those citizens who depend on buses for their mobility with a better service. But apart from these operational and social

objectives, bus priority, because of the high occupancy of buses compared with that of private cars, can have purely economic objectives in terms of an overall saving in passenger time and operating costs. There are a number of additional aims, such as conserving energy, improving the environment, altering the modal split in favor of public transport and improving the image of bus travel. Two important social objectives are these: improvements in job and/or educational opportunities caused by easier travel to workplaces and educational institutes.

Assessment Methodology

Where the objectives of a priority scheme can be expressed as a benefit in purely economic terms, the effects of the scheme should be quantified so that it can be judged objectively. In some cases, it may not be possible to express the important effects in economic terms, but at least they should be quantified as far as possible. In other cases, assessment of a scheme may have to rely on only a qualitative description of the results. However, the assessment is carried out, the implementing authority should make sure that the effects of each new scheme are monitored to ensure that it satisfies the stated objectives, because it is quite possible for a poorly-designed scheme to do more harm than good. Common sense dictates that such an assessment should be made, but unfortunately it is not always done. The importance of adequate assessment is underlined by the need to build a store of practical experience of priority measures so that in the future better schemes can be devised and more realistic design criteria established.

CONCLUSIONS

1. Increasing car ownership and dispersal of activities have together made conditions worse for public transport operators and users, and the granting of bus priorities is one way of helping buses to provide a better service, particularly for those who are becoming increasingly dependent on buses for their mobility.

2. Bus priority should, and normally does, help bus passengers, but it might well cause disbenefits to other road users. Ways of assessing the various benefits and disbenefits are described. When a package of bus priority and traffic engineering measures is introduced, the assessment should give the overall effect. If it is important to know the effects of some of the individual components, the implementation should be phased.

3. For maximum efficiency, with-flow bus lanes should allow buses to bypass queues of vehicles without reducing the capacity of the bottleneck which is causing those queues. This is achieved by stopping the bus lane short of the bottleneck (usually a signal-controlled junction) by an amount which depends on the degree of saturation of the junction; this "setback" is normally between 50 and 80 meters long.

4. The benefits (passenger time and bus operating cost savings) from with-flow bus lanes increase with increasing degree of saturation of the bottleneck and with increasing bus passenger flows. Such lanes are almost always justified when the degree of saturation exceeds 90 percent. If no "setback" is provided on the approach to a signal-controlled junction, the benefits depend even more on the bus passenger flow and on the ease of diverting excess traffic to other routes.

5. With-flow bus lanes are often not justified on strict economic grounds in off-peak periods, though, since benefits or disbenefits are likely to be small, other reasons (including simpler signing) may be overriding. Granting priority to other groups, e.g., taxis or carpools, can sometimes increase the benefits and hence the justification for the priority, particularly when bus flows are low.

6. Accident records suggest that there is the possibility of an increase in accidents following implementation of both with-flow and contra-flow lanes, but after a while this tends to settle down to a level lower than that which existed before implementation.

7. Contra-flow lanes are usually introduced to restore bus routes in a one-way system to their former locations prior to introduction of the system. Their justification depends on the amount of route diversion saved, bus passenger flow and the extra delay caused to other vehicles at junctions where the presence of the contra-flow lane adds complexity. Quite low bus flows in certain circumstances can justify the provision of a contra-flow lane. Typical time savings to buses are 4 to 5 minutes.

8. Contra-flow lanes almost always operate for the full 24 hours and unlike with-flow lanes are self-enforcing, but costs of implementation tend to be higher than for with-flow lanes. Loading and unloading operations are likely to cause more problems in contra-flow lanes than in with-flow lanes, but careful design based on local knowledge can usually overcome these.

9. When freeways are regularly congested at peak periods, bus lanes can provide substantial benefits to bus passengers and carpools (if these are also given priority) with little, if any, disbenefit to other users; they are particularly useful when bus journeys are long, and savings of up to 30 minutes have been

reported. Increased bus patronage and a greater amount of car-pooling have resulted from schemes of this type. The facility may take the form of a separated roadway built in the freeway median or on other "spare" land* or it may be a contra-flow or with-flow lane using the normal carriageway. This type of facility generally operates in peak periods only to serve journey-to-work traffic.

10. When freeways themselves are not congested but the access ramps are (possibly due to metering devices on the ramps restricting the flow entering the freeway), substantial benefits to bus passengers and/or carpools can be obtained by providing priority vehicles with separate access ramps or reserved lanes which allow them to bypass any queues at the metering devices. Reserved lanes on the approaches to toll booths can provide a similar service. Cost is not normally high and a satisfactory level of enforcement can usually be obtained.

11. Bus-only streets are becoming more popular. They benefit bus passengers and other road users who are allowed access and, where they are created from a normal street, the lot of the pedestrian is improved. Environmentally, they are not as pleasant as fully-pedestrianized streets, nor as safe; movement of pedestrians is more restricted, but they provide advantages for bus passengers and may be the only real alternative to a normal traffic street where rear access to shops and other premises is lacking.

12. Busways are expensive and in existing towns it is difficult to find suitable rights-of-way at acceptable costs. One example in a new town showed that the cost could be justified -- bus speeds were half as high again as on conventional services in similar towns and route lengths and walking distances were much shorter. A cheaper alternative may be to provide short sections of specially-built busway linking stretches of all-purpose roads.

13. When conditions do not justify the provision of bus lanes, priority can be given to specially-equipped buses approaching traffic signals (whether in area-wide traffic control schemes or at isolated junctions) so that the phasing, timing or progression (in the case of linked signals) favors buses in relation to other vehicles. In view of the higher passenger-carrying capacity of buses this treatment can lower the overall passenger delay. Practical examples of both types of schemes have provided worthwhile benefits.

14. A technique known as gating can be used to limit the number of vehicles entering a street (or area) to that volume which will allow the street (or area) to operate freely: buses can be given priority to bypass the queues formed at the "gates." This technique has been tried out in a number of cases, mostly single arterial roads, with beneficial results for buses and with little or no loss to other traffic.

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*The use of this space for construction of additional freeway lanes would not necessarily improve the traffic conditions on the freeway because congestion in peak periods is invariably caused by a lack of capacity at the exits.

15. Buses can be given priority by exempting them from prohibitions affecting turning movements at junctions, which only saves them time but retains the route location best suited to passengers. Buses leaving bus stops can be helped by giving them priority over other traffic, as is done in France and Belgium with satisfactory results, or by schemes to keep the area near bus stops clear of standing vehicles.

16. It is becoming increasingly common to incorporate bus priority into overall traffic and town planning measures for a whole town. Such comprehensive schemes generally divide the town center into non-interconnecting segments to prevent through movement of private traffic, restrict the numbers of vehicles entering the town center by "gating" or other methods, and pedestrianize large areas of the center. Bus services are generally upgraded over the whole town, while in the center bus lanes and bus-only streets provide direct routing between the central zones, while park-and-ride provision encourages motorists to transfer to bus.

17. Bus priority schemes have, in general, provided bus passengers (and carpools where appropriate) with worthwhile traveltime savings and occasionally with substantial ones. Disbenefits to other traffic have been minimal mainly due to the combination of bus priority with other traffic measures. Increases in bus patronage have generally not been large, except on some freeway priority schemes, nor has there been much shift from car to bus travel, but the results of the few comprehensive assessments which have taken place have indicated high cost/benefit ratios in almost all cases.

RECOMMENDATIONS

It is recommended* that:

1. The movement of people should be the main consideration of urban transport planning and not the movement of vehicles. Since buses form the mainstay of public transportation in urban areas, attempts should be made to assist their operation and free them from the effects of congestion.

2. Bus priority should always be considered if savings in passenger time and operating costs to those given priority are likely to exceed the losses sustained by other road users who

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*These recommendations were approved by the NATO Committee on the Challenges of Modern Society at the Spring Plenary Meeting of 27/28 April 1976.

may be adversely affected by the priority measures; even when this condition is not fulfilled, other non-quantifiable aspects may be of sufficient importance to make bus priority worthwhile.

3. Attempts should be made where practicable to encourage more effective utilization of road space by allowing other multi-occupancy vehicles (e.g., carpools) to share bus priority facilities, provided that undue adverse effects on bus travel can be avoided.

4. Wherever possible, bus priority should be an integral part of town and transport planning, aimed at ensuring that the quality of life for the inhabitants and users of the town is enhanced for all people, whether they are car users or not. Comprehensive schemes of this type may combine bus priority with pedestrianization, traffic restraint, traffic management and environmental measures to protect sensitive areas of town.

5. Bus priority schemes of particular interest should be assessed using agreed standard techniques and the information made freely available between countries so that gaps in present knowledge can be filled. Where a package of measures is to be introduced, consideration should be given to implementing it in stages so that assessment of the individual components can be carried out. This is particularly important in the case of certain measures where little is known of their likely benefits and disbenefits, but practical considerations may be overriding.

6. NATO Central Governments should take the necessary steps to see that this project report is distributed, in accordance with national practice, to the local officials in their countries who are responsible for implementing transportation improvements, in a manner that indicates the central government endorses the conclusions of this Project Report.

SUMMARY AND RECOMMENDATIONS

of the

CCMS/NATO - URBAN GOODS MOVEMENT PROJECT

The CCMS/NATO "Urban Goods Movement" Project was prepared by the Representatives of the U.S.A., the United Kingdom and France.

The following six topics have been studied:

(1) Traffic Problems

(2) Technical Problems

(3) Freight Terminals

(4) Regulation and Commercial Use, Planning

(5) Demonstration of New Projects

(6) Coordination of Study Methods

The first two topics concern the present situation.

Topic (1), prepared by the French, describes the nature of truck activities in cities (particularly pickup-and-delivery), and points to the differences in the "the UGM problem" and "the solution" among different cities in a given country as well as among the three countries (at the time this report was prepared, the U.S. appeared most concerned with air pollution and congestion, the U.K. with noise, and the French with congestion).

Recommendations:

(i) Accept urban truck trips as inevitable and attempt to minimize their costs by incorporating them into urban transportation studies and transportation regulations.

(ii) Emphasize local solutions implemented by local authorities to solve local problems.

(iii) Make a conscious decision whether to assign priority to goods movement or to passenger movements.

(iv) Distinguish congestion created by truck movements from congestion created by trucks parking at curbside to load and unload.

(v) Develop, on the model of the English study at Swindon, traffic simulation of goods movements on real urban road networks.

Topic (2), also prepared by the French, describes the features of a desirable UGM system, i.e., routing large, through intercity vehicles around urban areas (e.g., on circumferential highways), vehicles designed especially for the urban environment (e.g., quieter, lower emissions, greater maneuverability, etc.), and automatic equipment and modern distribution techniques (e.g., use of containers and freight consolidation).

Recommendations:

(i) Give greater attention to the design needs of trucks operating exclusively in urban areas (i.e., quieter, less polluting, more energy-efficient, easier access for loading and unloading, good visibility, good traffic performance, and power equipment where necessary).

(ii) Provide training in efficient goods-handling techniques to deliverymen and, if possible, to receivers.

Topic (3), prepared by the U.S. makes a strong plea for greater use of freight consolidation and coordinated pickup and delivery (e.g., along the lines of United Parcel) as a means of sharply reducing truck VMT, congestion, noise, fuel consumption and local distribution costs.

Recommendations:

(i) Make greater efforts to consolidate freight, e.g:

- for intercity freight shipments, at city of origin, city of destination, or both;
- for urban freight trips, by route, or by a system involving consolidation terminals and coordinated pickup and delivery.

(ii) Before attempting to implement freight consolidation schemes, give careful attention to possible institutional constraints (e.g., labor regulations, willingness of shippers, carriers and receivers to cooperate, and the degree of control necessary to assure success).

Topic 4, prepared by the U.K., describes the "service first" concept which has developed in the physical distribution field (i.e., arranging displays at stores, provide insurance, credit and assistance in customs, and inventory maintenance--all at higher rates), and the implications of this philosophy for changing UGM practices and for transportation planning. This report helps explain why rationalization of expensive operations is difficult to realize.

Recommendations:

(i) Consider the needs of the owners and carriers of goods before attempting to regulate or reorganize urban goods distribution.

(ii) Strike a balance between the cost of changing the way things are done, and the benefits hoped for through change.

(iii) Treat goods movements as an explicit land use in transportation planning, particularly with respect to truck parking, exclusive bus lanes, highway capacity, and pedestrian travel.

(iv) Through existing international organizations, achieve greater harmonization of road signs and hours of operation.

(v) Improve understanding of the urban physical distribution process, particularly loading and unloading.

Topic (5), prepared by the U.S., outlines a range of alternatives to improve UGM efficiency in the near term, intermediate range, and the long run.

Recommendations:

(i) Short-range improvements (1 year or less), e.g.:

- prepaid shipments
- dial-a-truck
- route consolidation
- rescheduling pickup and delivery
- economic incentives (road pricing and parking charges)

(ii) Intermediate range improvements (1-3 years), e.g.:

- consolidated pickup and delivery
- better use of containers
- simplified documentation

(iii) Long-range improvements (3-5 years or more), e.g.:

- improved design of cities
- improved design of buildings
- improved design of vehicles
- new transportation systems (e.g., pipelines)

- greater use of communications technology

(iv) Greater international cooperation in urban goods movement RD&D.

Topic (6), also prepared by the U.K., describes some of the methodological issues concerned with measuring and analyzing UGM for purposes of freight transportation planning (e.g., commodity classification and vehicle description).

Recommendations:

(i) To improve transportation planning, attempt to achieve greater uniformity among countries in commodity and vehicle classification.

(ii) Seek greater international harmony in commercial law and regulation.

SUMMARY AND RECOMMENDATIONS

of the

CCMS/NATO PROJECT: INTERMODAL CONSIDERATION AND EVALUATION OF SHORT-DISTANCE TRANSPORT TECHNIQUES

The CCMS/NATO project "Intermodal Consideration and Evaluation of Short-Distance Transport Techniques" is part of the CCMS Pilot Study on "Urban Transportation". It was carried out under the leadership of the Federal Ministry of Transport of the Federal Republic of Germany. The work of the study group was coordinated in the course of several meetings in which representatives of the following countries participated:

- Belgium
- Canada
- France
- Italy
- Netherlands
- United Kingdom
- U.S.A.

The working papers sent out to the participants before the meetings were prepared by the SNV - Studiengesellschaft fur Nahverkehr (Short-Distance Transport Studies Corporation) - Hamburg, on behalf of the German Federal Ministry of Transport. Members of the Corporation took a prominent part in the ensuing discussions.

SUMMARY:

The CCMS/NATO project is divided into four parts:

- Requirements of Short-Distance Transport Systems
- Inventory
- Assessment and Comparison
- Conclusions.

Different groups of people have different requirements with regard to short-distance transport systems. The study examines the various requirements from the points of view of

- passengers
- town and traffic planning
- community/environment, and
- public transport operators.

In each of the areas discussed, judgment criteria can be defined for the various requirements. For instance, one of the requirements of the community/environment sector is the reduction of air pollution. A sub-aspect of this requirement is exhaust gas emission. It can be transformed into a judgment criterion by specifying the type of exhaust gas to be considered (e.g., NO_x) and by fixing the desirable minimum as well as the maximum permissible values for emission (of NO_x). Thus the emission of NO_x is one "indicator" for the criterion exhaust gas emission. Each short-distance transport system produces a different contribution to this indicator (emission-level) which is used in the assessment.

The inventory is based on three elements:

- brief system descriptions
- description of existing transport systems and their future development
- description of new transport systems

Questionnaires for system data have been developed and annexed to the section containing the system descriptions. The explanatory notes attached describe which data and how to fill them in, with a view to ensuring the compatibility and comparability of the data provided. All short-distance transport systems are divided into eight groups. The characteristic features of the different groups are briefly described.

The section dealing with the description of existing short-distance transport systems and their future development covers rapid transit railways, tramways, motor buses as well as the system groups dual-mode and dial-a-bus; the difference between the latter two bus systems and the conventional bus consisting, in the first case, in an additional technical component (track-guidance), in the second case, in the operating concept (possibility of ordering or calling a bus).

One characteristic feature of new short-distance transport systems is automated operation, i.e., largely without driving personnel. No less typical are new technical components e.g., for support and guidance techniques, and a separate right-of-way, indispensible for automated operation.

Special-type railways, ships, boats, and helicopters have not been considered due to their limited importance for urban mass transport. Continuous conveyor systems are usually designed for distances of around 100 meters and therefore must be regarded primarily as complementary components of other major systems, e.g. in terminals.

The assessment and comparison of short-distance transport systems can be affected by means of formalizing assessment methods or by verbal comparison. Section 1 of chapter 3 outlines the three assessment approaches:

- cost-benefit analysis
- cost-effectiveness analysis
- multi-attribute utility analysis.

Since different groups of persons attribute different importances to the benefits/effectiveness, section 2 describes and gives examples of how they are determined. In the following section, short-distance transport systems are examined from the point of view of the different groups of persons with respect to the degree of fulfillment of the various assessment criteria. To permit technical differences between transport systems to be adequately included in an assessment, a special section of this chapter outlines individual component developments.

The chapter conclusions describes cost developments of transport systems.

Furthermore, it examines the prospects of new-type transport systems which are determined by

- the further development of existing systems
- the development of costs
- an estimate of the benefits arising from new systems for the different groups of people concerned (e.g., users, the general public).

Within the framework of the available data, the study puts forward general statements on costs as well as statements on the prospects for further technical development and estimated benefits. These statements permit one to make global judgments on individual system groups, following the breakdown given in the inventory chapter.

The study does not include a complete cost-benefit analysis - mainly because of the difficulties connected with cost quantification. In a comparison on an international scale, cost data can be used only with utmost care, owing to the difficulties arising in connection with exchange rates, time difference (data supplied by manufacturers), or because only estimated values are available (for new developments).

Furthermore it may be assumed that the importance attributed to the various assessment criteria will also differ from country to country. Therefore, any attempt to determine these importances on an international basis would inevitably level out existing differences and negatively affect the significance of these values for individual countries.

In conclusion, the study group agreed to put forward the following recommendations concerning existing and new short-distance transport systems:

RECOMMENDATIONS

If public transport is to be a true alternative to private transport, it must be able to meet certain standards in respect of travel speed, frequency and comfort which at present are met by only few public transport systems. Therefore, sustained efforts to promote and enhance public transport should be part of any policy aiming at an improvement of traffic conditions in local communities.

For the realization of such a policy, it is recommended that the following points be considered:

1. The efficiency of current operational systems should be improved to the maximum extent possible by better operation and integration of existing public transport systems.

2. Traveltimes can be significantly reduced only if separate rights-of-way are provided for public short-distance transport and private transport. In this context, attention should be paid to the fact that new as well as conventional systems with an exclusive right-of-way

   2.1 cause relatively high initial and subsequent expenditure

   2.2 necessitate a high traffic volume in order to keep costs per passenger-km relatively low.

3. Underground railways and rapid transit railways should be considered as likely alternatives for highly congested and trafficked routes, especially where the traffic volume is very high. Any decision in this context should, of course, be supported by a sound cost-benefit/effectiveness analysis.

4. For medium and higher traffic volumes, conventional tramways sharing their rights-of-way with private traffic cannot be favored. Where tramways are used in such environments, they should be upgraded and consideration given to their substitution by rapid transit systems.

5. Because the bus offers the greatest opportunity of universal utilization at low costs, it may be assumed that -- under present conditions -- the bus is and will continue to be the best suited mode of transport to meet present and future short-distance transport and urban requirements, either alone, or where appropriate, such as in larger cities and metropolitan areas, in combination with rail transport systems. This applies despite the low attractiveness attributed to buses (similarly with tramways) by the users. For this reason, and in view of the great scope for improvement, the bus is considered to have the relatively best development prospects and the further development of the bus appears particularly promising. Attention should also be given to further development of dual-mode and dial-a-bus systems.

6. It is particularly important that the promoters of new transport systems reduce the capital and operating costs in order to reach an economically attractive alternative to conventional systems.

7. Only systems with their own exclusive right-of-way (i.e., without grade-level crossings with other transport systems) can operate fully automated. For systems development a fully automated operation has to be considered since it offers advantages with respect to safety, punctuality, and energy savings, etc.

8. In general, a combination of passenger and goods transport within the same system does not seem feasible in short-distance (urban) transport. However, some small cabin systems could be an exception, provided that certain additional investments and operational modifications are made.

9. The use of cost-benefit/effectiveness analyses in short-distance transport decisionmaking should be greatly increased and their results taken into account. In this context, it is important that such analyses should be conducted as a general rule, even though not all benefits effects can be adequately quantified or measured. Special attention should however be paid to bringing these non-quantifiable benefits (or costs) into consideration.

APPENDIX B

SPECTRUM OF TRANSPORTATION SYSTEMS MANAGEMENT (TSM) ACTIONS

APPENDIX B

SPECTRUM OF TRANSPORTATION SYSTEMS MANAGEMENT ACTIONS

- TRAFFIC OPERATIONS MEASURES
  - Channelization
  - One-way streets
  - Better signalization and progressive timing
  - Computerized traffic control
  - Metering access to freeways
  - Other traffic engineering improvements.
- PEDESTRIAN AND BICYCLE MEASURES
  - Bicycle paths and exclusive bikeways
  - Pedestrian malls
  - Convenient and secure bicycle storage facilities
  - Other bicycle and pedestrian facilitation measures.
- PARKING MANAGEMENT AND CONTROL MEASURES
  - Elimination of on-street parking (especially in peak periods)
  - Regulation of the number and price of public and private parking spaces
  - Favoring short term over all-day commuter parking
  - Provision of fringe and transportation corridor parking to facilitate transfer to transit and other high occupancy vehicles
  - Strict enforcement of parking regulations

SOURCE: U.S. Department of Transportation, "Transportation Improvement Program, Part II", Federal Register 40, no. 181 (September 17, 1975): pp. 42976-81.

- REDUCING PEAK PERIOD DEMANDS - Changes in working schedules, fare structures, and automobile tolls to reduce peak period demands and encourage off-peak use of transportation and transit facilities
  - Staggered work hours
  - Flexible work hours
  - Reduced off-peak fares
  - Increased peak-hour commuter tolls on bridges and highways
- PRIORITY TECHNIQUES FOR HIGH-OCCUPANCY VEHICLES
  - Reserved or preferential lanes on freeways and city streets
  - Exclusive lanes to bypass congested points
  - Exclusive lanes at toll plazas with provisions for non-step toll collection
  - Exclusive access ramps to freeways
  - Bus pre-emption of traffic signals
  - Strict enforcement of reserved transit rights-of-way
  - Special turning lanes or exemption of buses from turning restrictions
- GENERAL MEASURES - Actions to reduce vehicle use in congested areas, improve transit service and increase the efficiency of internal transit management
  - Encourage carpooling and other forms of ride sharing
  - Organize employer-supported vanpool programs
  - Diversion, exclusion or metering of automobile access to specific areas
  - Area licensing, parking surcharges, and other forms of congestion pricing
  - Establishing auto-free or auto-restricted zones and closure of selected streets to through traffic
  - Restrictions on downtown truck delivery in peak hours
  - Better transit services, including route deviation and demand-responsive services in low density areas

- Greater flexibility and responsiveness in transit routing, scheduling and dispatching
- Express bus services coordinated with local collection and distribution services
- Fringe, and park-and-ride facilities
- Shuttle transit service from fringe parking areas to urban centers
- Integrating paratransit services with public transportation
- Simplified fare collection systems and policies
- Passenger amenities, including shelters
- Better passenger information services and systems
- Improved marketing
- Cost accounting and other management tools
- Maintenance policies to increase equipment reliability
- Surveillance and communications technology